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Types of normal breast- and bottle- fed infants.

**1. Baby Y., 14 months. Bottle-fed from birth. 2. B. J. S., 11 months. Bottle-fed after 4th month. 3. E. S., 6 months. Breast-fed.**

A PRACTICAL TREATISE

ON

# INFANT FEEDING

AND

## ALLIED TOPICS

FOR PHYSICIANS AND STUDENTS

BY

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# DEDICATION

IN REVERENT AND AFFECTIONATE MEMORY
OF MY MOTHER

HENRIETTA LOWENBURG

# PREFACE.

THE author's purpose in publishing a work upon "Infant Feeding and Allied Topics" is to meet the many requests received from his students and from his medical colleagues who have honored him with their confidence. The contents will be found to be largely clinical and practical, and to embody the author's personal experience with the problems presented. Theorizing and the presentation of a medley of views of different authorities have been studiously avoided. Credit has not always been given for views expressed which are not original, although the attempt has been made to do so where the fact stated is eminently new and, as yet, has not become a part of common medical knowledge. Quotations and references have been avoided as much as possible, as they are time-consuming and generally annoying, distracting the mind of the reader from the text. In not a few instances the author has indulged in the repetition of certain facts and statements. This has been done largely for the sake of emphasis and to insure the individual completeness of the presentation of the particular topic under discussion, and also to avoid references and cross-references.

A serious attempt has been made to emphasize the importance of breast feeding and the digestive problems which present themselves in this class of patients.

The influence of the German school of pediatrics has been presented in a conservative way, and simply includes

the author's personal experience with the ideas promulgated by this brilliant coterie of workers.

Adherence to the percentage idea, in its broader sense, has been maintained, as furnishing a valuable method of thinking, and not as a *"conditio, sine qua non,"* the idea being that individualization is the basic principle of successful infant feeding. The advantages and disadvantages of the caloric system have been discussed.

As a means of adapting milk to the individual requirements the top-milk methods and the milk-and-cream mixture methods have been abandoned as being too cumbersome, and often incomprehensible to both the physician and to the caretaker. The dilution of whole or of skimmed milk is advocated as simple and efficient. Where their use has given good results the author recommends a few proprietaries, not as substitutes for, but as adjuvants to cows' milk.

The author's thanks are due, and are hereby gratefully acknowledged, to Prof. John B. Deaver, who has written the article upon "Surgical Treatment of Infantile Pyloric Obstruction."

To his sister, Miss Sara Lowenburg, the author wishes to express his appreciation for her assistance while the work was passing through the press. To Robert A. Schless, senior student at Jefferson Medical College, and to Malvin H. Reinheimer, Esq., for their unselfish and enthusiastic assistance in reading proof, and preparing the index, the author is likewise gratefully indebted. The majority of the Röntgenograms were made by Dr. Geo. Rosenbaum, of Mt. Sinai Hospital, Philadelphia.

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# CHAPTER I.

## BREAST FEEDING.

### MATERNAL AND MEDICAL RESPONSIBILITY.

PHYSICIANS have long recognized that the best food for an infant is human milk. In spite of this, thousands of children continue to be placed upon artificial feeding, some to thrive, some to live and to suffer from nutritional diseases, and some to die. The responsibility for the failure to conserve the maternal milk-supply, while dual, rests with greater weight upon the physician, who, while realizing the value of natural and the dangers and uncertainties of artificial feeding, has failed to become fired with that enthusiasm which the subject demands. Consequently many mothers are lacking in enthusiasm.

It must be stated, first, that the majority of women, providing they are disease-free, can nurse their young. The physician should, therefore, from the day that his patient comes under his charge for her expected confinement, point out to her at every opportunity the advantages of maternal nursing and the dangers of bottle feeding. It is a grave error, too often committed, to discontinue the breast at the first sign of indigestion in the newborn,—an occurrence so common that it may almost be regarded as normal. A mother, on the other hand, will frequently believe that her baby is not getting sufficient nourishment or that her milk is too weak or too rich, and that altogether she is unfit, both from her own and the standpoint of her infant's health,

to suckle her babe. The *psychic* element, represented by fear and uncertainty in the mother's mind, is a very potent cause for the discontinuance of maternal feeding and is exceedingly difficult and sometimes impossible to overcome. In fact, fear and anxiety may cause a temporary suspension of the lacteal flow, just as of the other secretions,—saliva, for instance. The physician here again fails in his function if he thoughtlessly coincides with the mother's ideas without investigation. True it is that there are contraindications to maternal feeding, but these will really be found to be few. In our zeal to secure some substitute for or imitation of human milk, we have been carried away from the truism that nothing is quite so good as the real article, and that, if we would but have it, there is plenty of it at hand; and that the study of its conservation is perhaps the most urgent duty of the pediatrist and of the practitioner.

*The best guide as to a particular woman's ability to nurse is the physical condition of her babe.* If its weekly gain equals from 5 to 7 ounces or even a little less, then nothing else need be considered. In spite of this, on the plea that the milk is insufficient in quantity and quality, although the simple process of weighing the infant before and immediately after nursing for a few times was not practised; or that the infant failed to gain weight (even in the absence of a milk analysis); or that it suffered from digestive disturbances, physicians are daily sacrificing the human milk-supply. Granted that these conditions are realities, one may pertinently ask "Do they constitute a sufficient reason to stop breast feeding?" Certainly not! As will be pointed out later, there are methods of conservation and of correction whereby the milk can be increased in quantity or whereby any or all of the various elements

may be augmented or diminished. These it is the physician's duty to know and to practise. The mother, on her part, should look to her medical advisor alone, and not depend upon the gratuitous advice of well-meaning but poorly informed friends.

Breast feeding may be done either by the *mother* (maternal nursing) or by a *wet-nurse* (wet-nursing). The

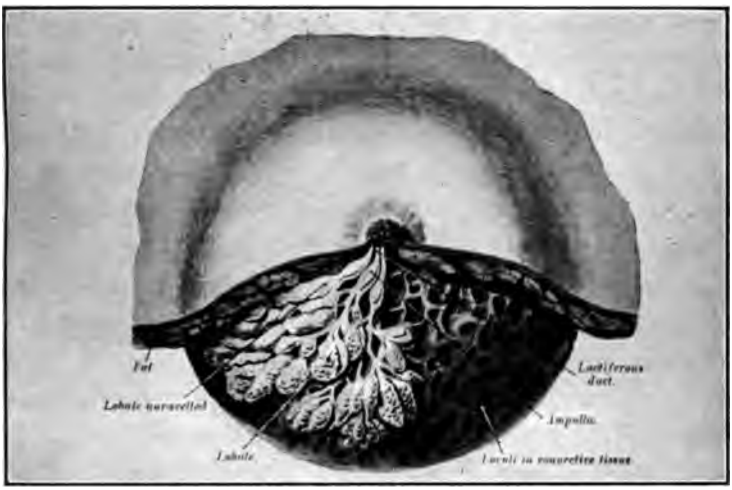


Fig. 1.—The mammary gland. (Gray.)

former is by far the more satisfactory. The latter is useful in emergency. As the milk is secreted by the mammary glands, the construction and function of these organs should be understood.

## MAMMARY GLAND.

The mammæ, or breasts, secrete the milk and are two, large, hemispherical eminences situated on the lateral aspect of the chest, between the third and the sixth or seventh ribs, and between the sternum and the axilla (Fig. 1). They

vary in size in different women and in the same woman, depending upon the physiologic activity of the uterus. The left breast is a trifle larger than the right. Before puberty they are insignificant, but increase in size as the generative organs develop. During pregnancy they enlarge and remain so during active lactation. The shape of the organ, as a rule, changes from a circular convex outline to a large, pendent mass. The nipple is a small, conical eminence placed just below the centre of the gland. The skin covering the nipple and surrounding its base contains pigment, the amount and character of which depend upon the type of woman (blonde or brunette) and upon the activity of the gland. This pigment, called the areola, in the virgin is of a delicate rose tint. As pregnancy advances it becomes darker and spreads over a larger area, extending from the base of the nipple over the surface of the gland (secondary areola).

In brunettes of pronounced type this secondary pigmentation may be black. The skin covering the surface of the gland, besides being pigmented, also becomes striated much after the fashion of the skin of the abdomen. The nipple contains involuntary muscle-fibre, which, under sexual excitement or the irritation produced by the infant's lips, contracts, causing the nipple to become erect. The nipple is perforated at its tip by the numerous orifices of the galactophorous ducts. Around the base of the nipple are found several sebaceous glands which serve to keep the skin in a pliable condition (glands of Montgomery). Numerous nerves find their endings in the cutaneous papillæ of the nipple.

*Histologically* the mammæ are tubo-racemose glands (Piersol), containing fifteen to twenty lobes, which are

separated and supported by masses of adipose tissue and by fibrous septa, which divide the lobes into lobules and these again into acini. These acini are lined by a low columnar epithelium, which varies in character, depending upon the functional activity of the gland. These cells, resting upon a membrana propria, rapidly multiply and oil-droplets appear within them. These gradually increase in amount and coalesce until they occupy almost the entire content of the cell, crowding the nucleus and the protoplasm to one side. As the amount of oil increases the cells become distended and finally rupture, the oil being discharged into the lumen of the acinus, where, becoming mixed with an albuminous secretion and epithelial *débris,* constitutes the secretion of the gland, or milk. The cells near the centre of the acinus undergo fatty degeneration and are discharged for a few days following the establishment of lactation. These cells constitute the large colostrum corpuscles (Fig. 6) which persist for a week or ten days, and the first secretion is known as colostrum. The milk is carried off by means of ducts which extend from each acinus. These are called lactiferous ducts, and they unite with those from other acini and form the lobular duct which joins with those from other lobules, and finally this union terminates into the lobar duct or galactophorous duct, which passes as a single tube, ununited, from each lobe and opens by a separate outlet into the apex of the nipple. Just before it reaches the apex of the nipple, each duct dilates into a pouch or ampulla. These ampullæ act as reservoirs for the milk. The ducts are lined with low columnar epithelium which rests upon a membrana propria, and each duct possesses a fibrous coat which contains elastic tissue and some unstriped muscle-fibre. As the ducts approach the surface of the

nipple the lining epithelium becomes stratified and continuous with that of the epidermis.

The internal mammary, the thoracic branches of the axillary, and the intercostal arteries supply these organs with blood, and their branches penetrate the entire gland, even surrounding the acini in a capillary network. The venous blood from the interior of the gland is carried by venules to the circulus venosus surrounding the nipple. Thence large branches carry the blood to the circumference, terminating in the axillary and the internal mammary veins. The lymphatics empty for the most part into the anterior axillary glands and some few into the anterior mediastinal glands. During lactation the vascular supply to the mammæ is increased and the veins become decidedly prominent. The anterior and lateral nerves of the thorax supply the mammæ with innervation.

### HYGIENE OF THE BREAST AND NIPPLES.

After each nursing, the nipples are gently cleansed with a piece of absorbent cotton moistened with boric acid solution and gently dried. The infant's mouth is cleansed in a similar manner with a mild antiseptic alkaline solution. Before nursing the nipples should also be cleansed. No milk should be permitted to dry or to sour upon the nipple, as digestive disturbances are likely to follow as well as mammary infection. Excoriations and fissures of the nipples may cause excruciating pain. They can often be prevented by bathing the parts during the entire period of gestation with a solution of alum in alcohol, thereby rendering the epithelium tough. When present, temporary suspension of breast feeding may become necessary for a few days, or the artificial nipple may be employed (Fig. 2). Experience

with this instrument is not always satisfactory. It may annoy the mother, and the infant may not take to it kindly. A better method is to withdraw the milk by manual manipulation, and to feed it to the baby through a bottle or by means of a spoon. The application of some sedative dusting powder, as equal parts of bismuth and boric acid, is often

Fig. 2.—Artificial nipple or nipple-shield.

serviceable. Before nursing, the powder should be carefully wiped away. Indolent fissures are stimulated to healing by touching them with a stick of silver nitrate. Compresses wet with a 10 per cent. solution of argyrol or ichthyol are also useful. Better than all these is a paste made from equal parts of bismuth subnitrate and castor oil. An ointment of calendula, prepared by homeopathic pharmacies, applied to the sore places, has often yielded good results.

## ECZEMA OF NIPPLES DURING PUERPERIUM.

Eczema of the nipples and of the neighboring integument is a troublesome complication of the puerperium and may seriously interfere with nursing. Water should be kept away from the parts. The condition usually yields to the combination of castor oil and bismuth. If there be present indurated fissures, salicylic acid gr. x and lanolin ℥j will usually cause them to heal.

## DEPRESSED NIPPLES.

The nipples may be depressed below the surface of the gland, or they may be inverted or even absent. The depression may disappear under the stimulus of sexual excitement or of the infant's lips. Depressed or inverted nipples may be a serious handicap to maternal feeding. For this reason throughout the puerperium, the mother should be taught to daily draw the nipple out with her fingers or with the breast pump. It is surprising, on the other hand, to note, in some cases wherein the galactophorous ducts open directly upon the surface of the glands with practically no nipple, with what ease the infant seizes the breast and maternal feeding is successfully accomplished.

## CAKING AND ABSCESS OF THE BREAST.

If the milk enters the breast too rapidly, or if it fails to be withdrawn, by proper nursing, it collects in the lactiferous tubules and in the acini of the mammary gland, causing them to distend. This is known as *caking*. The breast becomes exceedingly painful and, especially in the dependent portions, are felt the hard and tender lobes of the gland. Caking is best prevented by regular and steady nursing. If in spite of this an excess of milk is secreted,

the breast pump (Fig. 3) may be used to remove the excess, and the breasts are gently massaged with warm oil several times a day, care being exercised to make the stroke in the direction of the ducts, from the base toward the nipple (Fig. 4, *A* and *B*).

*Abscess* of the breast is a preventable as well as a lamentable accident. It results directly from mammary infection. Infection may be carried into the lobules of the glands through cracks in the nipple, through eczematous excoriations, by the mouth of the infant, and by the decomposition of milk left to dry upon an imperfect nipple. The nurse or physician may carry infection to the breast by undue manipulation.

Fig. 3.—Breast-pump. (Physician's Supply Co., of Phila.)

**Symptoms.**—Abscess may appear at any time during the nursing period. It is more common during the earlier weeks. There may be few if any *constitutional symptoms*. On the other hand, the general reaction may be severe, the patient complaining of chilly sensations or suffering a real rigor. The temperature rises to 101° F. or to 103° F. (rarely higher), and the pulse is proportionately increased. Anorexia and nausea, as well as headache and neuromuscular pains occur. The tongue is coated and the bowels become constipated.

*Locally* there appears a small or a large, circumscribed spot of induration which is tender and which varies in size from a marble to a walnut. More than one such area may thus appear. The overlying skin becomes bright red. It is not at first adherent, but later becomes so. The color darkens, the area softens, often increasing to an enormous size, spreading not only superficially, but deeper into the substance of the gland. The skin is hot, the pain intense, and fluctuation is made out with ease or difficulty, depending upon the depth of the infection. Spontaneous rupture may occur with a disappearance of general symptoms, to be followed by slow healing and perhaps one or more remaining sinuses, which may or may not intercommunicate. These sinuses may persist for months.

**Treatment.**—Aside from *incision* and *drainage,* as soon as fluctuation manifests itself, the effect of mammary abscess upon the future ability of the mother to nurse her babe must be seriously considered. At first thought it would appear that a mammary gland, once infected, is lost to the infant forever. While true in most cases, one must discriminate and determine each case individually. *The size and the position of the abscess, and also whether or not pus is being secreted at the nipple, largely influence the decision.* This may be recognized by the naked eye; or bacteria, pus cells, and perhaps blood may be discovered by the microscope. If the other breast be healthy it may yield sufficient milk. At least partial breast feeding should be employed. If on the other hand, as in a case in point, in which the abscess was as large as a marble and in which no pus appeared at the nipple by reason of the fact that the galactophorous duct leading to it, between it and the abscess, was obliterated by an adhesive inflammation, the infant will not receive any

*A*

*B*

Fig. 4.—Massaging breast. The motion starts at the base of the organ (*A*) and, by a circular or spinning movement of the hands, ends at the nipple (*B*).

infected material, there is no reason why, after incision and drainage, nursing should not go on, provided the nipple can be protected (Fig. 5).

*Incision into a mammary abscess should be made in a manner radiating from the nipple, and not encircling it, in order to prevent severing of the healthy ducts.*

*Internally* the mother should receive a gentle laxative, as cascara, or a small dose of castor oil. An enema may


Fig. 5.—Abscesses not interfering with breast feeding.

suffice to open the bowels. The diet is limited to fluids, and in order to combat toxemia a daily enema of normal salt solution (to be retained) or continuous rectal proctoclysis are valuable adjuncts. Head and body pains and fever may be relieved by small doses of aspirin, codein and extract of aconite root. If the mother feels too ill to nurse the infant, it may be temporarily withdrawn from the breasts for from twenty-four to seventy-two hours. In the mean time it should be placed upon a weak mixture of condensed milk and water. The healthy breast should be massaged and the pump applied to prevent caking. When healing

is slow search should be made in the mother for tuberculosis or for some depressing diathesis. Change of air, good food, Basham's mixture or iron citrate, with other tonics, hypodermically, should be used. Autogenous or stock vaccines should also be employed as adjuvants.

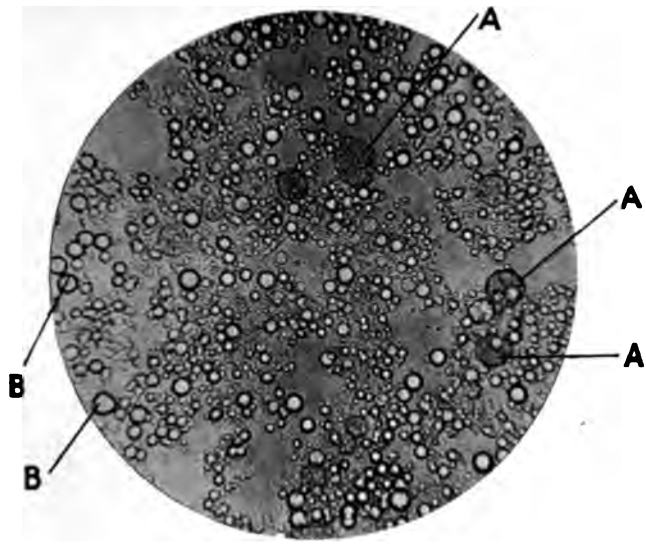


Fig. 6.—Microphotograph of colostrum. *A*, the large nucleated and granular colostrum corpuscles; *B*, oil globules.

## COLOSTRUM.

About the third day of the puerperium milk makes its appearance in the mother's breast. This first lacteal secretion is not really milk, but consists largely of water and is comparatively rich in protein. It is known as *colostrum* and microscopically contains large, granular, corpuscular bodies, about five times the size of milk-corpuscles. They are known as *colostrum* corpuscles, and probably represent desquamated epithelial cells which line the acini of the mam-

mary gland (Fig. 6). Colostrum also contains globules of oil. Its composition is variable, as indicated by the table of Harrington, quoted by Rotch:—

| | I | II | III | IV | V |
|---|---|---|---|---|---|
| Fat | 1.40 | 0.68 | 2.40 | 5.73 | 4.40 |
| Milk-sugar and proteins | 9.44 | 11.53 | 11.15 | 10.69 | 11.27 |
| Ash | 0.17 | 0.31 | 0.25 | 0.16 | 0.21 |
| Total solids | 11.01 | 12.52 | 13.80 | 16.58 | 15.88 |
| Water | 88.99 | 87.48 | 86.20 | 83.42 | 84.12 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

As indicated, the quantity of fat is comparatively low; while the percentages of milk-sugar and of proteins are high and uniform. The function of colostrum is but little understood. It probably does not contribute to the nutrition of the infant. In fact, the reverse is true, for during the first week of life the infant's weight is diminished. Its effect is probably that of a laxative, ridding the bowel of meconium. Colostrum disappears in about one week to ten days, and is replaced by true milk.

### CHEMISTRY AND PHYSICS OF HUMAN MILK.

Human milk, as well as cows' milk, is an *emulsion*. It is an opaque fluid, bluish white in appearance, and has a sweet, palatable *taste*. Its *reaction* is alkaline or amphoteric when freshly drawn. The *specific gravity* varies between 1029 and 1030.

*Under the microscope* the milk is seen to consist of a *fluid portion* and of *corpuscular elements* (Fig. 7, *A*). These corpuscles are minute, evenly divided, fat globules, which are held in suspension. When milk is acted upon by rennin and slightly warmed it coagulates. The coagu-

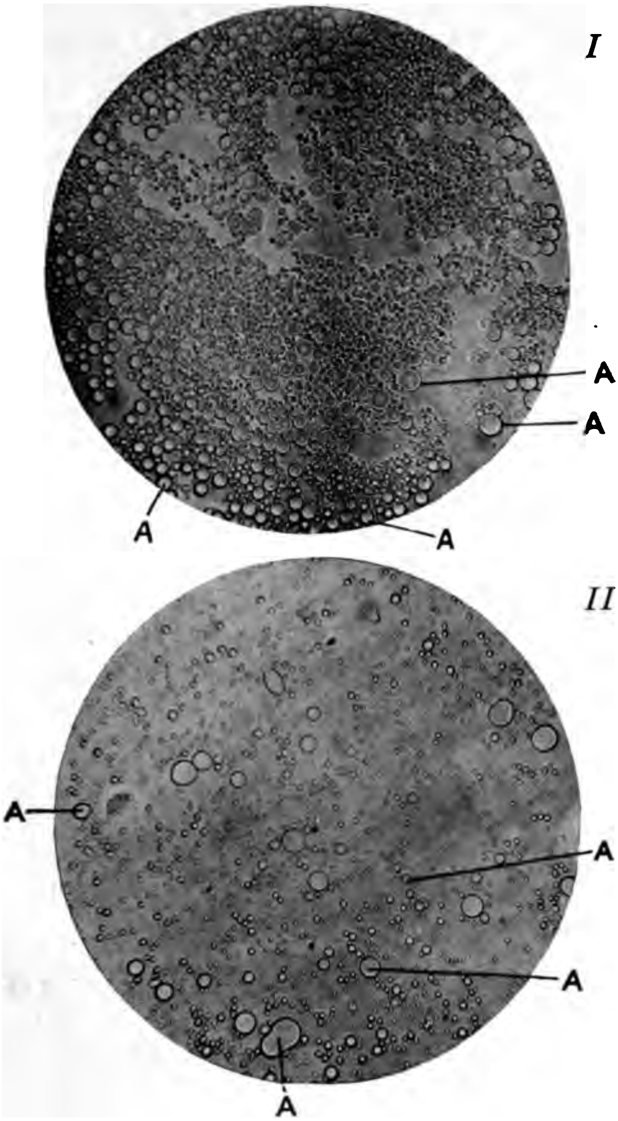


**Fig. 7.—Microphotograph of human and of cows' milk. I. Normal human milk showing uniformity in size of fat globules (*A*). The apparent smallness in the size of those in the centre is due to the focusing. Note the absence of epithelial cells and leucocytes. The presence of the latter would indicate inflammation of the breast, probably beginning abscess. II. Cows' milk showing the comparative irregularity in the size (larger) and shape of the fat globules (*A*) with reference to human milk. Also note the absence of epithelial cells and leucocytes, showing the teat to be free of inflammation.**

lum consists of *calcium paracasein* (casein) or *principal protein constituent* of the milk, in the meshes of which are contained the fat globules. In the normal state this protein exists as *calcium casein* (caseinogen). From the coagulum exudes a clear, watery fluid called *whey*. Whey contains the soluble and *non-coagulable proteins*,[1] *lactalbumin* and *lactoglobulin*. The former is coagulated by heat; the latter is not. Whey also contains the *salts* and *sugar of milk* in solution and a small amount of fat. Two-thirds of the protein in human milk are lactalbumin and lactoglobulin. In cows' milk but one-fourth of the total protein is composed of these constituents.

The *chemical composition* of human milk varies. It varies in different women and in the same woman at different periods of the same nursing and at different times throughout the entire period of lactation. The composition varies as to the number of daily feedings and the length of each feeding. It also depends upon the character and quantity of the mother's food, her environment, temperament, the care she has received during her accouchement, and the amount of physical exercise. *The nearer to nature a woman lives, the more normal will be her milk-supply.*

The percentage of *fat* is the most variable constituent. It is the lightest element in milk, and, if the milk be permitted to stand, it rises to the surface and constitutes *cream*. *Cream* does not consist entirely of fat, but contains the other chemical substances found in milk. According to Holt, the ratio of the fat to the cream is as 3 is to 5. The fats of milk are composed of *stearin, olein,* and *palmitin,* and are in fixed combinations, the amount of volatile fatty acids being decidedly less than in cows' milk.

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[1] Non-coagulable with reference to renin.

PLATE I

Meconium.

The percentage of *carbohydrates* (milk-sugar) rises rapidly after the first few days of lactation and gradually increases to the end. The sugar of milk, *lactose,* is a white, crystalline substance obtained by the evaporation of whey.

The *proteins* are plentiful in the beginning, but gradually diminish as lactation draws toward the close. The same is true of the *salts,* which consist principally of the phosphates of sodium, potassium, calcium, and magnesium, and the chlorids of potassium and sodium and a trace of organic iron.

The average composition of human milk is represented by the following table:—

ANALYSIS OF HUMAN MILK.

| | |
|---|---|
| Proteins | 1.5 to 2% |
| Fat | 3.5 to 4% |
| Sugar | 6 to 7% |
| Ash | 0.2 to 1% |
| Total solids | 11.2 to 14% |
| Water | 88.8 to 86% |
| | 100% 100% |
| Reaction | Alkaline or amphoteric. |
| Specific gravity | 1029 to 1030 |

## BACTERIOLOGY OF HUMAN MILK.

Human milk is practically sterile. The only organisms which are found under healthy conditions are those which normally, or rather for the time being, as non-pathogenic germs, inhabit the skin. These represent the *Staphylococci epidermidis albus,* and *Pyogenes albus, citreus* and *aureus.* In the presence of disease of the gland all varieties of pathogenic bacteria have been found. The typhoid bacillus and the pneumococcus have been recovered in cases

of typhoid fever and of pneumonia, as well as the tubercle bacillus in the presence of local tubercular disease. Roger and Garrier report the presence of tubercle bacilli in breast milk in a patient who died of pulmonary and laryngeal tuberculosis.

## ANALYSIS OF HUMAN MILK.

**Sample.**— A sample of milk for analysis is obtained by a breast pump, or, better, by stripping the ducts gently and

Fig. 8.—Stripping of breast for sample by running the thumb and index-finger from the periphery to the base of the nipple, where pressure is exerted. The stream thus produced is caught in a glass until a sufficient amount (about an ounce) is obtained for analysis.

receiving the milk into a glass (Fig. 8). The first milk may be discarded. The sample should consist of portions taken throughout the day at different times of the nursing period, and should be secured from both breasts. This gives an average of the milk received by the baby. Breast pumps are of several kinds, the one pictured in the cut (Fig. 3) being the most familiar, simple in construction, and easily cleansed. As a rule, however, the use of these

instruments is tedious and unsatisfactory. The pump and the bottle which is to receive the sample should be sterilized.

The *color* of human milk is bluish white in appearance. It has no characteristic *odor*.

*A* *B*

Fig. 9.—Lactometer. (Physician's Supply Co., of Phila.)

**Reaction.**— This is tested by litmus-paper.

**Specific Gravity.**—This is determined by an ordinary urinometer or a special lactometer (Fig. 9). The milk is put into a small cylinder, *A*, and the instrument, *B*, is lowered into the former with a slight spin to avoid sticking to the

sides. When it has come to rest the graduation on the neck is read. The temperature of the milk should be 60° F. The specific gravity furnishes crude but valuable comparative data for clinical purposes. Thus the fat, being the lightest constituent of milk, when in excess would cause the specific gravity to be low, provided the other solid constituents were normal. Conversely, under the same conditions a high specific gravity would indicate that the percentage of fat must be low. If the percentage of fat is normal and the specific gravity is high, this would indicate that the remaining solids were high. The reverse means that there is a deficiency of the other solids. Therefore, too, if the specific gravity be normal and the fats are high, the other solids are high. If the fat be low and the specific gravity is normal, then the other solids are low.

TABLE SHOWING RELATION OF KNOWN PERCENTAGE OF FAT AND SPECIFIC GRAVITY TO REMAINING SOLIDS.

| | | |
|---|---|---|
| High fat and normal specific gravity | = | High remaining solids. |
| Low fat and normal specific gravity | = | Low remaining solids. |
| High fat and high specific gravity | = | High remaining solids. |
| Low fat and high specific gravity | = | Low remaining solids. |
| High fat and low specific gravity | = | Low remaining solids. |
| Low fat and low specific gravity | = | Low remaining solids. |

**Daily Quantity Secreted.**— This is with difficulty determined, and can only be estimated by weighing a baby which is gaining steadily, before and after each feeding throughout the entire twenty-four hours. From several such daily assays an average can be struck. The following table from Holt[1] gives approximate quantities which may serve as a guide:—

[1] Holt, "Diseases of Infancy and Childhood," page 130, 6th edition.

| | Ounces. | Grams. |
|---|---|---|
| At the end of the first week ................ | 10 to 16 | 300 to 500 |
| During second week ....................... | 13 to 18 | 400 to 550 |
| During third week ........................ | 14 to 24 | 430 to 720 |
| During fourth week ....................... | 16 to 26 | 500 to 800 |
| From the fifth to thirteenth week ......... | 20 to 34 | 600 to 1030 |
| From the fourth to sixth month ........... | 24 to 38 | 720 to 1150 |
| From the sixth to the ninth month ........ | 30 to 40 | 900 to 1220 |

**Determination of Fat.**—The simplest method is by the *cream gauge devised by Holt* (Fig. 10). The only objection to its use is that it requires twenty-four hours. The instrument is graduated into 100 parts and is fitted with a ground-glass stopper. It is filled to the zero mark with milk, and is allowed to stand for twenty-four hours at room temperature. The volume occupied by the cream is then read off. The percentage of fat to the cream is as 3 is to 5. This mathematical formula is arbitrary. The results, however, are useful for practical purposes, as it is possible to learn whether an increase or a diminution has taken place, provided a record of each examination is kept.

A simple and accurate method is the *test of Babcock*. Place in the special percentage centrifuge tube (Fig. 11), by means of a graduated pipette (Fig. 12), 17.6 c.c. of milk. Clean the pipette and add 17.6 c.c. of strong sulphuric acid, holding the percentage tube in an inclined position. The acid sinks to the bottom. Mix the two liquids by means of a rotary motion. The mixture becomes dark brown or black, and hot. The sulphuric acid dissolves the calcium paracasein, and the heat generated is sufficient to liquefy the fat. Place the percentage tube and contents in a centrifuge and rotate 1200 times a minute for six minutes. Now, by means of the pipette, run enough hot water into the percentage tube to bring the level of the fluid up to the highest graduation. Rotate again in the centrifuge for two minutes.

Note on the graduated neck the volume occupied by the fat. Each unit division indicates one unit per cent.

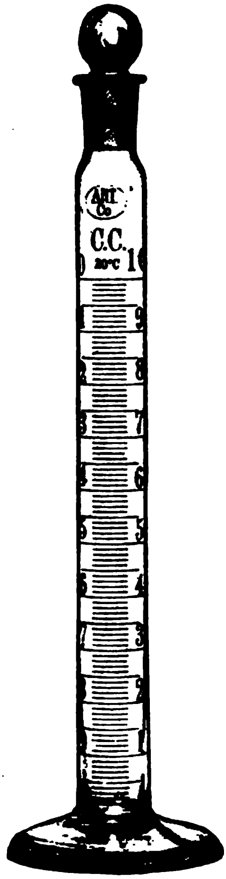


Fig. 10.—Creamometer for estimating percentage of fat. (Holt.)

Fig. 11.—Babcock's centrifuge tube for estimating fat. (Arthur H. Thomas Co.)

Readings can be made to one-fourth of 1 per cent. (0.25 per cent.).

**Determination of Proteins.**— If the specific gravity and the percentages of fat, sugar, and salts be known, the per-

centage of proteins may be calculated from the percentage of total solids. *The total solids equal the sum of one-*

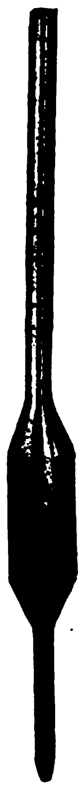


Fig. 12.—Babcock's pipette for estimating fat.

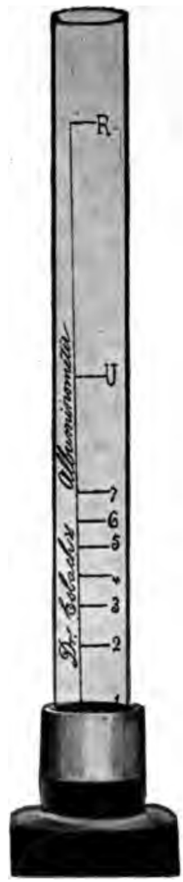



Fig. 13.—Eschbach's albuminometer used in protein test. (Arthur H. Thomas Co.)

*fourth of the last two figures of the specific gravity, plus six-fifths of the percentage of fat, plus 0.14.* This may be expressed as follows:—

$$\text{Total solids} = \frac{\text{Last two figures of S. Gr.}}{4} + \frac{(\% \text{ of fat} \times 6)}{5} + .14$$

This result minus the sum of the percentages of fat, sugar, and salts equals the percentage of proteins.

*Example.*—The specific gravity is 1030. The percentage of fat, sugar, and salts is, respectively, 4, 7, and 0.2.

$$\text{Total solids} = \frac{30}{4} + \frac{(4 \times 6)}{5} + .14 = 12.44\%$$

$$\begin{aligned}\text{Percentage of proteins} &= 12.44\% - (4\% + 7\% + 0.2\%)\\ &= 12.44\% - 11.2\% = 1.24\%.\end{aligned}$$

A more accurate method is that described by Kjeldahl, but is too complicated for practical purposes.

The following method provides accurate comparative data. The solution required consists of

Phosphotungstic acid, 25 Gm.
Distilled water, 125 c.c.

After thorough solution is obtained, add

Hydrochloric acid, concentrated, 25 c.c.
Distilled water, 100 c.c.

The solution if kept in a blue bottle will remain stable for a long while. Human milk is diluted 1 to 10, or, if the protein is thought to be very low, 1 to 5. The diluted milk is poured into an Esbach tube such as is used for the estimation of albumin in urine (Fig. 13) to the mark *U*. The solution is added to the mark *R*; the tube corked and slowly inverted 12 times. It is allowed to remain upright for twenty-four hours, and the percentage of protein is read at the level of the precipitate.

**Estimation of Lactose.**—The calcium casein is precipitated by acidulating the milk with acetic acid, and the

lactalbumin by boiling the acidulated mixture. Filter. Wash the precipitate with a measured quantity of distilled water, which is added to the filtrate. When cool, place in a burette and titrate with Fehling's solution, as when examining urine. The reduction factor for lactose differs from that of glucose, 10 c.c. of Fehling's solution being equivalent to 0.06 Gm. of lactose, instead of 0.05 Gm. of glucose.

**Microscopic Appearance.**—Human milk contains great numbers of small fat globules of uniform size floating in the watery portion of the milk (Fig. 7, I). Thus, it is seen to be a perfect emulsion. No other cellular elements aside from an occasional epithelial cell or a leucocyte are seen. The last two appearing in excess indicate an abnormality, usually inflammation or abscess.

## INDICATIONS FOR AND INTERPRETATION OF MILK ANALYSES.

For clinical purposes it is proper to inquire "When do conditions arise that demand or which would be benefited by a careful analysis of the milk which the infant is receiving, and how are these results to be interpreted?" Unless there be a distinct indication, the interest attached to such an examination is purely academic, and serves no practical purpose. On the other hand, if the infant is not thriving, or if there be evidences of indigestion and colic, or if the mother doubts the good quality of her milk, analyses are of use. "If the analysis shows the milk to be poor in all its constituents, does this mean that it is an unfit food for the particular baby receiving it?" Not necessarily. *The best guide is the condition of the baby itself,* and not infrequently is it seen that an infant will gain steadily on

what appears to be a weak milk, while another will not thrive on a rich one. If, however, there exists a combination of an undernourished babe together with a poor milk, the indication is clear to improve the quality of the mother's milk or to try mixed feeding, or, as a last resort, artificial feeding alone.

The value of a milk analysis, in determining which of the food elements of the breast milk are responsible for the symptoms of indigestion, is incalculable, and often is the means of saving to the infant the maternal milk. The information thus obtained frequently permits the physician to speedily correct the trouble through treatment of the mother.

Psychic influences exert a tremendous effect upon the secretion of breast milk, and if a milk analysis will convince a doubting, fearful, though willing woman, that her milk is of good quality, the time consumed and the expense will have been well worth while.

## ADVANTAGES OF BREAST FEEDING.

In his daily contact with his patients the general practitioner meets no question with more frequency than that dealing with the nutrition of the infants under his charge. His responsibility has been indicated already with reference to the necessity of attempting the conservation of the human milk-supply. The question may very properly be asked, "What are the advantages of breast feeding?" They involve both the *mother* and the *infant,* and if the physician has the facts ready at hand, many converts to the ranks of those who suckle their young, and thereby serve as a potent instrument in lowering infant mortality, will be gained by him.

*Gastrointestinal and nutritional diseases are responsible for 53.5 per cent. of all the deaths which occur in infants during the first year* (*Holt*). *Practically all of these are artificially fed.* This should be sufficient argument to encourage both physician and mother to conserve the milk-supply, and should at once take the right from both or either to arbitrarily decide whether the infant should receive the breast or not. It makes the obligation mandatory. Too frequently the breast is sacrificed because, without investigation, carelessly and heedlessly the physician or the mother, or the former yielding to the wishes of the latter, decides that the milk is unfit food for the baby. A woman may declare for a whim that she does not want to nurse her infant; that it will interfere with her social duties; that it is not æsthetic; that Doctor So-and-So knows how to feed babies artificially, and that she will put her infant under his care; that she has a friend who reared a baby on a popular patented food, and that she will do the same. These and many others are the reasons for withdrawing the breast. *Neither physician nor layman possesses an inherent right to destroy a helpless babe's means of sustenance. The obligation of marriage and motherhood carries with it to the healthy woman the obligation of maternal nursing for nine months at least.*

Digestive disturbances occur with less frequency and with less severity in the breast-fed. They are usually of no consequence, and seldom are associated with nutritional disturbance. Breast milk possesses antirachitic and antiscorbutic properties not found in any other food. In human milk there probably exists certain substances which confer upon the infant a natural immunity against the acute infectious diseases, as these occur with extreme rarity dur-

ing the first year, especially in the breast-fed. On the other hand, their incidence in this class of patients is marked by less severe symptoms and recovery is the rule. In the breast-fed dentition is rarely troublesome. Breast babies gain regularly in weight, sleep well, and are happy. The so-called dreaded second summer does not exist for the naturally fed infant, and danger of milk infection is absent. The food is always practically sterile, of the proper temperature, and requires no preparation.

From the mother's standpoint the knowledge of having a healthy child should be sufficient compensation for any material inconvenience which she fears she might have to endure. Some women honestly think they cannot nurse their infants or that their food is insufficient, consequently they discontinue nursing or use other foods in conjunction with it. It is difficult to convince these women as to the fallacy in their idea, and they go from one physician to another until they find one who places the baby upon "modified" milk. This usually disagrees, and when the infant has passed the gamut of all the patent foods and summer diarrhea it is returned to the specialist, dyspeptic and marantic, to be remodeled.

If feeding be conducted with system and regularity, the nursing mother will not be prevented from attending to her other duties. Between nursings she may rest, and go out, and after three months the baby may be trained to sleep from 8 P.M. until 6 A.M. The mother should not, on the other hand, be permitted to deceive herself with the idea that bottle feeding is easier than breast feeding. Aside from the uncertainty and dangers associated therewith, the former requires considerably more time on account of the necessity of preparation. This, taken in connection with

PLATE II

Normal breast stool.

the inconvenience caused by sickness, places artificial feeding at a decided disadvantage.

### INDICATIONS OF SUCCESSFUL FEEDING.

A baby thriving on the breast up to the first six months should gain from 5 to 7 ounces a week. It may be a little less or a little more. After this, while progressive, the weekly increase is less. The normal stool of a breast-fed infant is yellow, smooth, mushy, and free of particles and of mucus (Plate II). It has a pleasant, slightly acid odor, and is weakly acid in reaction. The bowels move from one to four times a day. Vomiting does not occur. The infant may regurgitate a little food just after feeding or when unduly handled. Unless viciously trained, it is happy, contented, does not cry, sleeps peacefully between feedings, and awakens regularly at feeding time.

### INDICATIONS OF UNSUCCESSFUL FEEDING.

If the infant does not thrive, if its gain in weight is small or unsteady, or it does not gain at all; if it vomits, has indigestion, is fretful and sleeps poorly, the cause will rarely lie in the mother's milk. More commonly there will be found some error in training, or the infant has received other food in addition, or is suffering from some organic disease of the gastrointestinal canal. Very commonly breast babies may be constipated, and the mothers are in the habit of daily using an injection or a suppository. Not only is this unnecessary, but in many instances is directly responsible for the inauguration and continuance of constipation. The mother should be taught to allow the infant to go thirty-six hours before resorting to laxatives, suppositories, or injections. At the end of this time, and usually before,

the baby will have had an evacuation. Before the breast is withdrawn as the cause of trouble, every other possible etiologic factor must be investigated.

### MOST COMMON CAUSES OF FAILURE OF MILK-SUPPLY AND HOW TO PREVENT THEM.

From the day that she places herself under her physician's care the prospective mother must not only be taught the importance of breast feeding, but more forcibly still must she have impressed upon her her ability to accomplish the act. Psychic phenomena, doubt and fear, especially, that the milk-supply is insufficient in quality or quantity or both, as before stated, are often responsible for the suspension of the flow. Such a case recently came to notice in which by persistent persuasion it was possible to carry the mother along for four months during the summer. Her milk-supply was scant. Each week she asked her physician for a formula, and each time was refused because her baby gained. In the fall, after weaning had been accomplished, she complained of an overabundance of milk, and means had to be taken to dry it up. Once the element of fear was removed, her milk-flow became plentiful. Shock, fright, or sudden joy may temporarily, but rarely permanently, impair the flow. Insufficient rest, a continuous round of social pleasures, excessive indulgence in alcohol, too much physical work and too little food, together with poverty, especially where the mother must go out to assist in earning her living,—all, by interfering with the proper metabolism of the maternal organism, inhibit or prevent the mammary secretion.

Any condition that causes a sudden or continuous loss of blood or of the other body fluids seriously menaces the

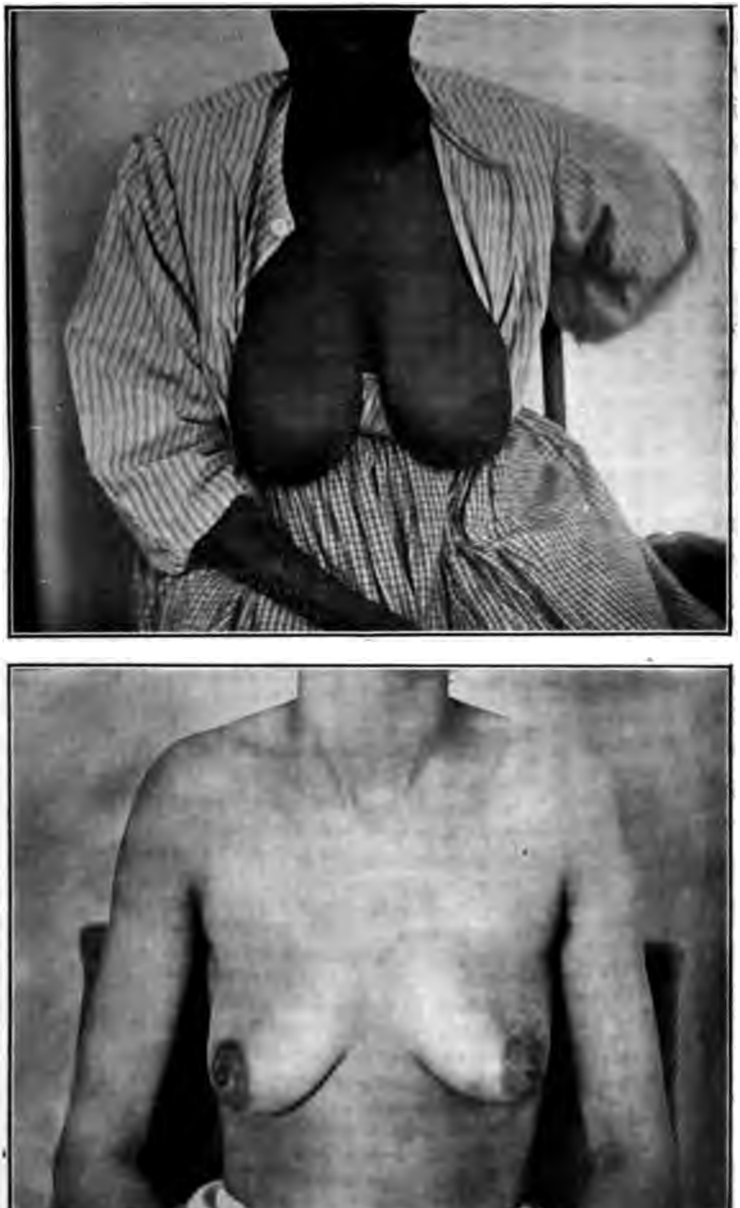


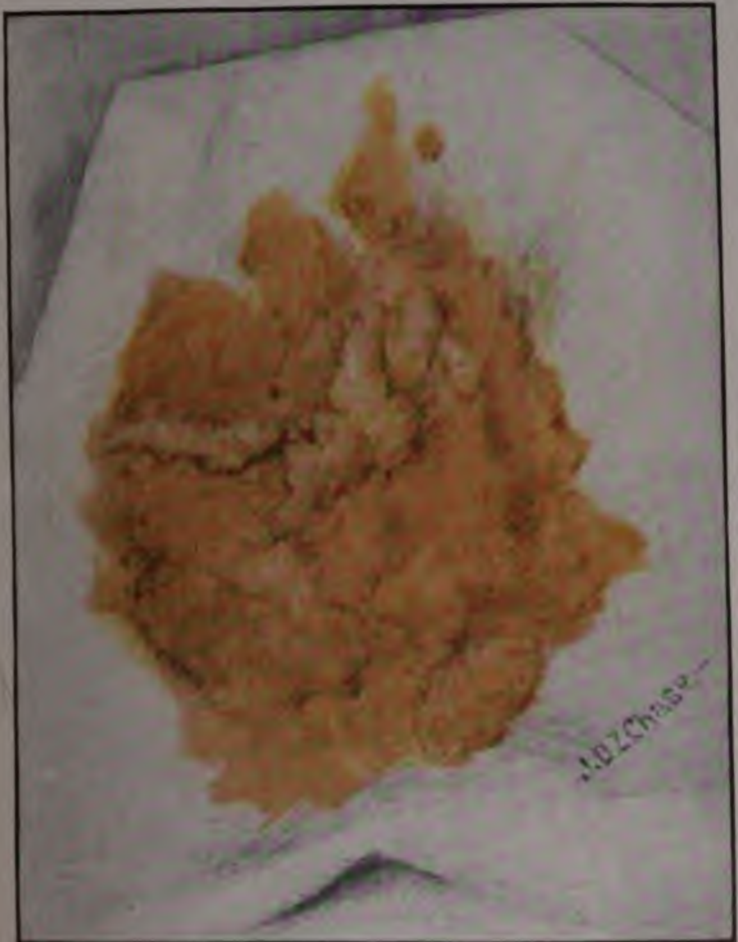
Fig. 14.—Types of good nursing breasts.

success of breast feeding. Of these, hemorrhage from the uterus, either at the time of labor or following it, especially in those cases which are permitted to arise from bed too soon, is a most potent factor. These cases are lamentable since they are preventable. Every labor case should be kept in bed at least two weeks, and in her room a week longer. If she start to bleed, she must be returned to bed and the source of the trouble sought. Menstruation occurring during lactation may or may not cause disturbances. Profuse vomiting, sweating, diarrhea, and excessive diuresis may destroy the supply. The remedy here is obvious—prevention if possible or cure as rapidly as can be accomplished. Chronic constitutional diseases may impair the quality of the milk in some instances, while in others it is remarkable how the quantity and quality both may be maintained. Nursing women should be protected from infection of all kinds. Congenital deficiency of glandular substance, especially in very fat women, is a serious condition, and very often cannot be overcome. The woman who has an abundance of milk is, as a rule, thin and wiry, with breasts that are somewhat pendulous, free of fat, and full of lobules which can be readily palpated (Fig. 14, *A* and *B*). Local disease of the nipple, eczema, excoriations, cracks and fissures, as a rule, may be prevented or yield rapidly to treatment.

## METABOLIC AND DIGESTIVE DISTURBANCES AND THEIR MANAGEMENT.

*During their first month nearly all breast babies suffer from indigestion.* Few escape it. Some continue to have it throughout the nursing period. Some present subjective symptoms. Some do not. The latter are in the majority. Some lose weight. Most of them continue to gain. The

PLATE III




Normal stool of artificially fed baby.

symptoms are largely objective and may be referred to the stomach and bowels. Vomiting in the suckling, as the direct result of dyspepsia, depends largely upon excessive individual feedings, too frequent feeding, undue handling, and upon an excess of fat or sugar in the mother's milk. Food comes up unchanged when vomiting occurs immediately after feeding, or, if appearing an hour or two later, it is sharply acid, smells like rancid butter, and is yellowish white in appearance. *Excessive fat* also causes loose bowels, which may contain considerable mucus. The movements average from four to five a day, are usually yellow, occasionally green, and contain white masses that resemble softly fried white of egg which has been chopped up and scattered throughout the yellow mass (Plate IV). These white masses are soluble in ether, readily burn, and are turned black by osmic acid. These babies usually have some colic and may be fretful and irritable. If the stool be placed in water, oil-drops float upon the surface. Sudan III, as stated elsewhere, has an affinity for fat, staining it a bright red.

If there be a *deficiency of fat,* the infant fails to gain, becomes constipated, irritable, and if the condition continues, rickets is a common sequence.

Indigestion depending upon an *excess of sugar* is marked by a sour, watery vomitus which burns the infant and causes it to cry. The bowels are loose and watery, highly acid, and excoriate the anus and buttocks. Colic is common. The temperature may reach several degrees above normal.

A *deficiency of sugar* causes subnormal temperature, loss of weight, irritability, and constipation.

*Protein excess* may or may not be associated with vomiting of curds. Most commonly the bowels are loose and

contain yellowish-white masses which are tough and which react to the test for protein (xanthoproteic). The movements (Plates IV and V) are green or yellow or yellowish green, and contain some mucus. The constipated dry, crumbly movement of protein excess (Plate VIII) is not met with in the breast-fed.

A *deficiency of protein* means underdevelopment, stationary or decreasing weight, late walking, late dentition, anemia, asthenia, constipation, and irritability. The condition may pass on to rickets.

An *excess of mineral matter* causes diarrhea; a *deficiency,* constipation and scurvy.

**Treatment.**—The most important thing to remember is that when symptoms of indigestion or of metabolic disturbances occur in the breast-fed, the first thing *not* to do is to take the child from the breast. This is commonly done, and from this time on dates the beginning of many cases of fatal diarrhea and inanition. *Indigestion in the breast-fed is not a serious condition, and usually lends itself readily to intelligent management. The essential thing is to watch the infant's weight from week to week, and its development.* If it shows a steady gain no change should be made. In any case, the breast should not be given up without at least one month's observation. In the mean time, if the symptoms be severe, an initial purge of castor oil may be given, although this is not often necessary unless the symptoms of colic be unusually severe. A hunger period, allowing only weak tea sweetened with saccharin, gr. j to the quart, answers best, and an earnest attempt should be made to modify the mother's milk (Chapter IX). If any of the ingredients are in excess, especially the fat or protein, a little plain water or barley-water, well diluted, should be given ten

minutes before feeding time in order to dilute the milk. More troublesome, and no more useful, is the withdrawal of the milk from the breast, diluting it and feeding it from a bottle. Colic, if troublesome, is usually relieved by the castor oil, or by 5 to 10 drops of the aromatic fluidextract of cascara, or by 5 to 10 drops of essence of peppermint in hot water, or half a dram to a dram of aqua camphoræ or aqua menthæ sodæ (soda mint) in conjunction with the hunger period. A spice poultice is soothing if applied to the belly. The same quieting effect may be secured by a warm asafetida enema or 10 to 30 mm. of the milk of asafetida by the mouth. After feeding, the following powder may be of service:—

| | |
|---|---|
| Extract of pancreatin (Fairchild's) .......... | gr. j to gr. ij. |
| Taka diastase (P. D. & Co.) ............... | gr. j to gr. ij. |
| Sac. lactis ................................ | gr. v. |

In cases with subnormal temperatures, external heat and massage with plain or with codliver oil are useful.

The further treatment includes an intelligent modification of the mother's milk based upon a correct diagnosis as to which of the ingredients of the milk are at fault.

## MODIFICATION OF MATERNAL MILK.

It has been shown how maternal milk may disagree with an infant owing to an excess or to a deficiency in any one of its chemical constituents. Such a contingency may, at times, be overcome by the use of certain hygienic measures which have the power of influencing the composition of the milk.

**Excess of Fat.**—This is a matter of individual idiosyncrasy. In reaching a conclusion the result of the analysis may not be taken alone. One infant may show disturbance

on 2 per cent. fat and another may tolerate 5 to 6 per cent. Give the mother a morning purge, preferably Epsom salts. Increase her liquids, especially water and weak tea. Increase her exercise. Lessen somewhat the amount of all food, especially milk, removing the cream from it in some cases. Cut down the proteins (beef, peas, and beans) and the fat in her diet.

**Deficiency of Fat.**—Control diarrhea, lessen exercise, and increase the beef and other proteins, and fat of her diet. Make her drink freely of rich milk. Give tonics and digestants to improve the maternal appetite. The addition to the diet of some preparation of malt or the weaker alcoholic beverages containing malt, such as porter, beer, and stout, is beneficial. Southworth's soup made by boiling 1 or 2 tablespoonfuls of cornmeal in a quart of water, to which some palatable flavoring has been added, when taken daily, is not only an efficient galactogogue, but increases the fat of the milk. A proprietary preparation known as Maltropon also yields good results.

**Excess of Protein.**—Increase the exercise. Increase fluids, especially water (2 to 3 quarts a day). Relieve constipation. Reduce vegetable and animal protein.

**Deficiency of Protein.**—Give tonics, as iron and phosphates. Lessen the exercise. Lessen water and other fluids. See that the diet contains plenty of milk, beef, peas, and beans. Give Southworth's soup and Maltropon.

**Excess of Sugar.**—Remove carbohydrates from the diet and prohibit the use of candy and rich desserts. Increase the fluid intake. Increase the exercise. Give an occasional saline.

**Deficiency of Sugar.**—Increase the carbohydrates, especially sugar. Lessen the amount of water. Lessen the

PLATE IV

Stool of indigestion in the breast-fed. Note white masses (fat and protein), mucus, and admixture of green and yellow color. A very common and important stool in the breast-fed. It does not call for a discontinuance of the breast milk, as so many mothers, nurses, and physicians seem to think. If the infant gains in weight, this stool should be ignored. It can be made normal by careful regulation of the mother's diet, plenty of water, a reduction in her milk, meat, and sugar intake, and the administration to the mother of an occasional saline. This stool, more than any other, is responsible indirectly for the high infant mortality during the first year, as when it appears it is regarded as a cause for commencing artificial feeding, and from this time the course of many infants is downward.

exercise. Order a daily allowance of beer, stout, or other malt preparations.

### HOW TO INCREASE THE TOTAL MILK SUPPLY.

The total quantity of milk may be deficient. The first indication is to control psychic disturbances. Any undue loss of blood or other of the body fluids must be prevented or stopped. At least two weeks' rest in bed after confinement must be enjoined. Following this the mother must secure plenty of rest, and later a sufficient amount of gentle exercise, together with an abundance of easily digested food. She should be made to drink freely of water, weak tea, and milk. These should be used, together with

**Galactogogues,** of which *cornmeal soup* (*Southworth's soup*) is an admirable one. *Maltropon* will also increase the total quantity of milk. One tablespoonful of this is mixed with a glass of cold milk or water and taken three times a day. Lutein derived from the corpus luteum of the hog is said to give good results. Placing the infant regularly to the breast is an excellent means of stimulating the flow of milk.

If the *supply of milk be excessive,* caking must be prevented by regular feeding intervals, the occasional use of the breast pump, hand-milking, gentle massage with warm oil, and the administration of gentle laxatives, as cascara or a small dose of Epsom salts.

### HOW TO DRY UP BREAST MILK.

This may be necessary on account of the death of the infant, the appearance of some contraindication to maternal feeding, the age of the infant (after 12 months) or the occurrence of some acute infectious disease. In the last

event, if the infant be the victim, it may not suckle the breast, but the milk should be withdrawn and fed from a bottle. This will materially increase its chances of recovery.

Practically all fluids must be withdrawn from the diet, including particularly water, milk, soups, alcoholic malt beverages, coffee, tea, and cocoa. Only a minimum of water is allowed. A daily saline must be administered. The breasts should be emptied by the pump or by manipulation, and both glands should be entirely covered (excepting the nipples) with belladonna ointment. Lint compresses, in which holes are cut for the nipples, are applied and the whole covered by a snug figure-of-8 bandage supporting both breasts. Should the organs become painful within a few hours, the bandage must be loosened or removed, the glands emptied by the pump, and the whole dressing reapplied. A little milk may remain for months.

### METHOD OF FEEDING INFANTS AT THE BREAST.

An infant should be placed at the breast immediately after birth. The theory that this aids uterine contraction seems to have some foundation in fact. From birth up to the period of 6 weeks an infant should be fed every two hours during the day and twice during the night. The first feeding should be given at 6 P.M. and the last at 8 P.M. The feedings during the night should be given at 12 midnight and at 4 A.M. If the child awakens oftener, a little warm sterile water may be administered. To insure the cultivation of the habit of regularity, the child, if sleeping, should be awakened for its food during the day. Toward the end of this period one of the night feedings should be omitted. Each feeding should not occupy more than fifteen or twenty minutes. The infant must not be permitted to

Fig. 15.—How to hold an infant while at the breast. The head and back are supported by one forearm and hand while the index- and middle- fingers of the free hand control the flow of milk, either hastening it by a stripping motion or slowing it by pressure.

sleep with the nipple in its mouth. The infant must be held in such a position as to insure its comfort. The mother supports its head and back upon her right arm if the child is nursing the right breast, and with the fingers of the left hand controls the flow of milk from the nipple (Fig. 15). The infant nurses the breasts alternately at successive feedings, unless there be a scanty supply of milk, then both breasts are nursed at each feeding. From the second to the fourth month the breast is given every two and a half hours with only one nocturnal feeding, and the latter gradually omitted. From the fourth to the ninth month the feeding intervals should be increased to three and a half hours, and the nocturnal nourishment is entirely omitted. From this period up to 12 months food is given every four hours. The hours and intervals of feeding are indicated in the following table:—

FEEDING SCHEME.

| Age. | Feeding interval. | Time of feeding. | Nocturnal feeding. |
|---|---|---|---|
| 1 to 6 wks. | 2 hours | A.M. 6, 8, 10<br>P.M. 12, 2, 4, 6, 8 | Two. |
| 2 to 4 mons. | 2½ hours | A.M. 6, 8.30, 11<br>P.M. 1.30, 4, 6.30, 9 | One. |
| 4 to 8 mons. | 3 hours | A.M. 6, 9<br>P.M. 12, 3, 6, 9 | None. |
| 8 to 10 mons. | 3½ hours | A.M. 7, 10.30<br>P.M. 2, 5.30, 9 | None. |
| 10 to 12 mons. | 4 hours | A.M. 7, 11<br>P.M. 3, 7, 10 | None. |

A healthy infant, after receiving its nourishment, passes into a sound sleep. After the child has had its meal it should not be carried around nor shaken, but quietly laid in its crib. Otherwise regurgitation of food will occur. Under special conditions the feeding interval may, even during the very early periods of life, be lengthened to three or to four hours. These will be pointed out as we proceed.

PLATE V

Stool of dyspepsia. Occurs in both the breast-fed and bottle-fed baby. In the former its significance can often be disregarded, if the weight remains unimpaired, or the mother's diet may be regulated as in Plate IV. In the bottle-fed, institute a hunger period for twenty-four hours. Then reduce the fat and the sugar in the formula, and at the same time administer the protein mechanically and chemically modified. (See text.)

## CONTRAINDICATIONS TO MATERNAL FEEDING.

A woman's milk may be insufficient in quantity and of poor quality. The quality may be good, but the quantity may be small. Any or all of these conditions may constitute a contraindication against maternal feeding if they cannot be corrected or if they interfere with the infant's nutrition. Painful fissures may cause a temporary suspension of nursing. Abscesses of the breast usually contraindicate breast feeding, as do painful and septic conditions of the infant's mouth. Mothers who suffer from epilepsy, nervous exhaustion, chorea, idiocy, profound anemia, tuberculosis, the acute infectious diseases, syphilis contracted after delivery, and profuse hemorrhage, should not suckle their young. A woman who has become pregnant while nursing her infant should cease doing so, as the strain of supplying nourishment to both fetus and child, besides herself, is too great. Menstruation, also, is regarded by some as a contraindication to breast feeding. This is altogether a question of the individual, and, if the child's nutrition and digestion are not disturbed, menstruation, *per se,* should not prevent the infant from nursing. A woman suffering from puerperal eclampsia or Bright's disease should not nurse her child. Malignant disease contraindicates maternal feeding. The breast should be withdrawn, temporarily, from a nursling suffering from acute alimentary intoxication. The physician should hesitate long before he advises the withdrawal of the breast. Each case is a law unto itself and must be decided on its merits. Tuberculosis and chronic valvular disease, with broken compensation, prevent nursing.

An infant born of a syphilitic mother should be nursed by that mother even if it shows no external evidences of

syphilis. It cannot be infected, not on account of immunity, but because the child probably has latent syphilis, as would be shown by a positive Wassermann reaction (Profeta's law). So, too, a woman apparently free of syphilis should nurse her babe if it be markedly infected. She will not become infected (Colles's law). The reason of this is because she, too, has latent syphilis, as shown by a positive Wassermann reaction. Thus a scientific explanation for both these laws is available. In the first instance, if she contracts syphilis after the birth of her babe, nursing must necessarily be discontinued. The susceptibility of the infant under such circumstances is apparent.

### HYGIENE OF THE NURSING MOTHER.

Many women who object to nursing do so from the belief that they thereby surrender themselves for a period of twelve months to a lonely existence, devoid of all pleasure and social intercourse. This is an erroneous idea, and it becomes the physician's duty to make plain to the mother her obligation to her child. From the day of conception, or from the time she comes under her medical advisor's care, every prospective mother should have inculcated within her a desire to nurse her infant. Mother-love, often absent during the first period of gestation, gradually develops in most women as the day of labor draws near. To this the physician should appeal, and make known to his patient the dangers and vicissitudes of artificial feeding even at its best.

Many women resort to bottle feeding through ignorance, or through the enticing advertisements to be found in medical journals and upon the labels of proprietary foods. These make infant feeding an easy matter, setting at naught

the work of some of the best minds of the profession; and the eager mother, in her zeal to raise her infant with the least care, discovers her mistake when it is too late, when her child, with a fatal pneumonia, or a mortal attack of summer diarrhea, or other acute infectious disease, succumbs because it did not have the vital force to resist the disease—because it was not breast-fed! The physician should, therefore, preach the gospel of maternal nursing day in and day out. By doing so, he not only fulfills his duty to his patient, and stands as the defender of helpless infancy, but renders invaluable service to his State. By doing less he fails in the fulfillment of his mission.

Between the nursing periods the mother should spend her leisure in useful and healthful recreation. She should indulge regularly in gentle outdoor exercise. Reading and participation in any desirable pastime should be encouraged. Rest is essential to her well-being, and mental excitement, fear, and worry are to be avoided. She should partake freely of easily digestible and nutritious foods, and, if accustomed to a glass of beer or light wine with her midday meal, this should be permitted. Intemperance, however, in all things must be interdicted. Daily bathing and a perfect digestion are conducive to a sufficient and nutritious supply of milk.

Care should be exercised in administering drugs to the nursing woman. Certain medicines are eliminated in the milk, and exert their physiologic effect upon the infant. Therefore such drugs as the saline purgatives, morphin, colchicum, belladonna, arsenic, antimony, mercury, and the iodids should be administered cautiously, if at all, to the lactating mother. The care of the nipple, as indicated elsewhere, should also engage the attention of the physician.

## BREAST FEEDING DURING ILLNESS OF MOTHER OR CHILD.

Whether or not breast feeding is to be continued under these circumstances is largely a problem that must be decided upon the merits of the individual case. The attitude of the physician, however, had best be conservative in most instances. Undue haste by needlessly sacrificing the milk-supply and hazarding the health and life of the infant may lead to disaster. Reference is here made especially to the beginning of an acute illness in the mother, in which the milk, as a rule, should not be withdrawn until the diagnosis has been made, or if an acute infectious disease be reasonably anticipated. The child's safety then demands immediate removal. The maternal illness may last but a day or two, and keen disappointment will follow hurried advice to feed the baby otherwise than by the breast. If it be advisable—for instance, if a surgical operation of minor importance must be performed—to withhold maternal milk for twenty-four or forty-eight hours, then the infant may be placed upon a weak milk mixture or condensed milk. After a day or two it is an easy matter to rehabilitate the flow by the administration of fluids, cornmeal soup, and Maltropon. It is especially in cases of this type, and in the harmless digestive disturbances of the breast-fed, that the physician can rise above the ordinary level by recognizing and meeting his opportunity for conserving the maternal milk-supply, while his colleagues of less discernment will thoughtlessly sacrifice it.

Illness in the infant is rarely a cause for stopping the breast. Septic conditions of the mouth and throat, or an acute infectious disease may be a good cause to remove the

infant from the breast, but not from the breast milk. It should be pumped out and fed by the bottle or dropper.

### WET-NURSING.

Next to maternal feeding, the milk of a healthy wet-nurse is undoubtedly the safest food for an infant under 1 year of age. The selection of a wet-nurse should be left to the medical attendant, who must subject her to a rigid physical examination before she is accepted. Her family history should be carefully scrutinized and her past and present medical history examined. A woman, the offspring of tuberculous, syphilitic, or cancerous parents, must be rejected. Her health should be perfect. She should have sound teeth, normal mucous membranes, good digestion, healthy lungs, and a sound heart and normal kidneys. Her skin must be free of all suspicious rashes, and her venereal and child-bearing history carefully examined. A Wassermann test must be performed on every applicant for the position of wet-nurse. If she has frequently aborted, or has given birth to many stillborn children, she should be rejected. Her milk should be analyzed in order to establish its nutrient qualities. This is not always necessary, as the health of her own infant will usually give sufficient information as to the quality of her milk. Her breasts should be normal and well developed, free from rhagades, ulcers, and malignant disease.

A nurse who is suffering from any form of infectious or suppurative disease, however slight it may be, should not be engaged. The same applies to one who is irritable, nervous, epileptic, or choreic. She should have a just appreciation of her duty and a sincere love for children. She need not be especially intelligent. Probably the

best test for a wet-nurse is the condition of her own child, which should be healthy and thriving. If possible, other things being equal, a multipara should be given preference, although a primipara need not be rejected for this fact alone. As a rule, however, young women of 17 or 18 make poor wet-nurses.

In the family who has engaged her, a wet-nurse occupies a peculiar position. If a good nurse, her services are often invaluable, a fact which should not be too strongly impressed upon her or she may turn tyrant. She should be treated with kindness and courtesy, be well-housed, well-fed and well-clothed, in addition to the ordinary compensation which she receives. The same care should be accorded her as to a nursing mother, and she should be made to adopt the same hygienic and prophylactic measures which pertain to the mother, taking sufficient rest, outdoor exercise, and diversion.

Should her milk disagree with the infant, either in its digestibility or in its capacity to supply sufficient nourishment, as evidenced by the infant's weight and strength, she should be discharged and another nurse substituted. *A syphilitic baby should not be permitted to nurse a healthy wet-nurse.* Care should be exercised that she does not slight her charge by giving all her milk to her own infant.

**Indications.**—Wet-nursing is urgently useful in the care of premature infants, in cases of very weak infants with whom no modification of cows' milk will agree, and who are threatened with, or are already suffering from, inanition. Should the mother die suddenly the outlook for a very young though healthy infant becomes brighter, as the result of a few months of wet-nursing.

## WEANING.

By weaning is meant the withdrawal of breast milk and the use of stronger food. In reference to babies who have been reared without the breast, the change means the gradual cessation of bottle feeding and the addition of solids to the diet. Weaning, to be done successfully, must be done gradually in most cases. In others, as the result of the death of the mother, failure of the milk-supply, maternal ill-health, or other cause, it must be accomplished rapidly. With wasted infants, who, at the age of 20 to 24 months with many teeth, are still at the breast, no time should be lost. Ordinarily weaning should take place between the ages of 10 months and 12 months. Some practitioners commence to give an occasional bottle at 6 months. This, as a general practice, is unnecessary. It is best to wean after the child has cut several teeth. This is an indication, in itself, that the gastrointestinal glands have reached a more advanced stage of development, and are capable of digesting stronger food. The infant should not be weaned while cutting a tooth. It should, under no circumstances, if possible, be weaned during the summer months. The fall and the winter are the best times of the year. The entire time occupied before the breast is finally relinquished, under ordinary conditions, is about two to four weeks. At first one breast feeding is omitted a day and its place is taken by a bottle, the composition of the contained milk being similar to that of the mother's milk. The infant is kept on this for three or four days or a week before another change is made. At this time another bottle feeding is substituted for a breast feeding, provided the digestive organs of the child have not been deranged. The same rule is followed and no change is made for another few days. This method

is continued until the bottle feedings entirely displace the breast. Now follows the change in the character of the milk mixture fed. As the child gains in weight and strength and the digestive organs remain normal, the strength of the milk mixture is gradually increased from week to week until the formula corresponds to undiluted cows' milk. At this period, about the age of 12 to 14 months, the use of the bottle is gradually discontinued, and the milk is fed by a spoon or drunk from a cup. The child has now from 8 to 14 teeth, and soft, farinaceous substances are gradually added. Milk-toast, well-cooked rice, oatmeal, mashed baked potatoes, tapioca, cream of wheat, farina, meat-juice, the wing of a spring chicken, baked apple, stewed prunes, soft-boiled eggs, and egg-custard are some of the substances which may slowly be added to the diet toward the close of the first or at the beginning of the second year. The meals are gradually reduced to three a day, with milk or some other form of light nourishment given between. The fullest meal is given at noon and the lightest at 6 P.M.

After dentition is complete, other substances may be carefully added and the child be permitted to sit at the table with the family. Such articles, however, as pastries, candy, nuts, pork, veal, rich gravies, fancy dressings, bananas, fresh bread, hot cakes, muffins, turnips, cabbage, radishes, corn, salt and smoked fish and meats are to be carefully eliminated. The child should be taught to chew its food slowly and well, and not to overeat. By watchful care and judicious management it can be easily taught to relish those things which are wholesome, and to refuse those which are indigestible. The diet presented in Chapter III, page 140, may now be used to great advantage.

# CHAPTER II.

## ARTIFICIAL FEEDING.

### EXPLANATORY AND HISTORICAL.

THE textbook presentation of this subject is most difficult inasmuch as long experience is of immense importance. Especially is this so at the present time, since the matter is by no means settled. The development of the scientific artificial feeding of infants, up to within a few years ago, was essentially American. Since then the teachings of the German school of pediatrists, represented by Czerny, Keller, Finkelstein, Meyer, Heubner, Rubner, Monti, Escherich, and others, have made their influence felt on the medical mind.

At first, analyses of human milk and of cows' milk were made and the marked quantitative and qualitative differences between the coagulable protein of these two milks were noted. Under the initiative of Pepper and Meigs in America the simple diluting of cows' milk, so that the various percentages resembled those of human milk, was advised and practised. To this diluted milk were added milk-sugar and cream to make up for their deficiency incident to the dilution of the cows' milk. These mixtures were soon found wanting in many cases, because the dilution and additions were not sufficient to overcome certain intrinsic biologic and physical differences, many infants failing to thrive upon a milk which nature primarily intended for cows, even though the percentages fed accurately equaled those of the accepted analyses of human milk. It was

found, for instance, that a child could digest 4 per cent. of fat of human milk, but that the same percentage represented by cow-fat often caused disturbance. This fact being recognized, it was decided, under the leadership of Rotch, of Boston, that the basic principle was to recognize digestive disturbances as dependent upon the fat, protein, or sugar, as the case may be, and to feed to the infant certain definite percentages of each ingredient and to increase or diminish them at will according to the indications. From this was evolved the idea of the *laboratory method,* or the *percentage method,* or the *American system* of infant feeding. From this sprang into existence the Walker-Gordon laboratory, which sought to fill the physician's prescription for any combination of percentages which he might desire. This, however, was soon found to be impracticable for the reason that the laboratories were confined to large cities, and that the cost of the production of definite percentage mixtures was beyond the means of the poor, who needed it most. The idea behind the percentage method seemed to be a good one, *i.e.,* to feed gradually increasing amounts of the various ingredients as the individual case required, and to increase or diminish any special ingredient as the indication arose.

For this reason the so-called *home modification* of milk was devised, and in this connection the work of Chapin, Holt, Baner, and others is representative. This embraced the so-called *top milk* and the *milk-and-cream mixture* methods. They are of immense practical value when intelligently applied, and serve a useful purpose in the evolution of scientific feeding. Many physicians seem, however, to be unable to thoroughly grasp the details of these methods, and experience has shown that as good results can

be obtained by the simple dilution of whole or of skimmed milk. This method will be described as we proceed.

Later it developed that any modification which failed to recognize the physical difference between the calcium paracasein (curd) of human and that of cows' milk would likely fail unless something were done to render the curd of the latter more pregnable to the digestive juices by causing it to be broken up into particles resembling the coagulated flocculi of human milk. Jacobi years ago, and Chapin more recently, advocated the addition of cereal decoctions or thin gruels made from barley, oatmeal, rice, etc., to dilute the milk instead of plain water. Chapin recommended that these cereal waters be dextrinized. Since then other methods of dealing with the coagulable protein, which will be described later, have been evolved. Still, in spite of careful percentage manipulation and the attempted adaptation of the milk to the individual's digestive capacity, failures were numerous.

It now came to pass that the micro-organisms were regarded as the important causes of mischief, and that every percentage formula might fail unless the basis of it was germ-free milk. From this arose in succession the advocacy of sterilized, pasteurized, and of certified milk. Under the impetus given by Coit, milk commissions exist in nearly all the large cities and towns of America, and clean milk (certified milk) is regarded as an essential of successful feeding.

More recently, the Germans have adopted the so-called caloric method of feeding. This seeks to provide a sufficiency of heat units as required by the weight of the child. At least 45 calories for every pound of weight are regarded as necessary. The Germans ignore the percentage composi-

tion of the mixture. In this their proposal is weak, since it fails to attempt to recognize the particular ingredient which may be at fault in an individual case. It has been well said that the number of calories necessary may be represented by a ham sandwich, and yet the infant could not digest it. The German school also denies the etiologic influence of the curd as a factor in indigestion, and of micro-organisms as the cause of summer diarrhea. They regard the fat as a chief offender, the protein as harmless, and look upon the fermentation of milk-sugar as the chief cause of this frequently fatal disorder of the heated season. While the German idea in a sense simplifies the problem, many of their claims have not been substantiated clinically, at least in America, and their plan of feeding can be made as dogmatic and unindividual as it is claimed that the percentage method of feeding is. The points of advantage and of disadvantage will be emphasized in the text as the problems present themselves.

It can be readily realized that the subject is far from settled, that no textbook outline of it can make a successful feeder of the novice. What is necessary in each instance is *individualization* and *experience*. The former is absolutely the keynote of success. "What is meat for one is poison for another" applies nowhere with such force as in the artificial feeding of infants. In the following presentation no claim is made to originality. Facts will be stated as they have been learned from personal clinical observation obtained in an extensive hospital experience here and abroad, and in private work and from contact with eminent authority. In some instances it may be necessary to plead guilty of being ultra-conservative and, perhaps, even unscientific. The other's right to his view is recognized, nor

is it denied that other methods are productive of as good results in the hands of their advocates. Liberality of views, however, and the elastic interpretation of facts and, above all, absolute individualization which the two former insure whatever the method employed, are claimed to be essentials, if the physician would become a successful feeder.

## SUBSTITUTES FOR HUMAN MILK.

For this purpose the milk of lower animals has been appropriated, and means sought to adapt it to human needs. The choice of animal depends considerably upon circumstances and the environmental influences of the country. Almost universally cows' milk has been employed, although use has also been made of the milk of goats, asses, and mares. Of the last three, the first alone is used with any great frequency, and largely in rural districts and among the foreign population. The composition of goats' milk follows:—

| | Per cent. |
|---|---|
| Fat | 4.50 |
| Sugar | 4.00 |
| Protein | 4.50 |
| Mineral matter | 0.60 |
| Total solids | 13.60 |
| Water | 86.40 |

This approaches the character of cows' milk and, like the latter, is deficient in sugar and richer in protein than human milk. The curd is finer than that of cows' milk.

## CHEMISTRY AND PHYSICS OF COWS' MILK.

Like human milk, the composition is not uniform. It varies in the same cow at different periods of the milking, and varies in the different udders. Thus the composition of the milk of a single cow might differ considerably from that

of an entire herd. The practical uniformity in composition of herd milk makes it more preferable for general purposes than that of a single cow. However, the danger of tubercular infection, for obvious reasons, is less from the milk of a single cow, properly examined. The composition also varies with the type of cow. Some cows are better adapted to infant feeding than others. Thus the Jersey and the Guernsey furnish milk rich in fat (over 5 per cent.) and one in which the fat emulsion is less perfect than in the milk derived from a Holstein-Friesian or the Ayrshire. The former furnishes milk relatively low in fat (less than 3 per cent.) and protein as well (less than 4 per cent.). The milk from the latter is rich in protein (over 4 per cent.) and weaker in fat (slightly under 4 per cent.). The milk from both these types is well adapted to infant feeding. The Devon and Durham cows resemble each other in furnishing a milk of good average richness.

*Cows' milk,* like human milk, is an opaque emulsion of fat in a solution of albuminous material, lactose, and mineral matter. The *color* is white or yellowish white. The *odor* is said to be characteristic, and is also determined by disease or by the diet of the cow. Thus, in the spring of the year, the odor of grass or garlic is common. The *specific gravity* at 60° F. varies from 1029 to 1034. Its oscillations depend upon the composition of the milk. The *reaction* is amphoteric, leaning toward acid. It becomes acid a few hours after milking, the acidity increasing with age. The addition of preservatives increases the alkalinity.

The *fat* of cows' milk contains olein, stearin, and palmitin. It exists in considerable proportion as volatile fats which are readily decomposed. If milk be allowed to stand,

the fat being the lightest portion of it, rises to the surface and is known as cream.

*Cream,* therefore, is simply superfatted milk. If the cream be removed by skimming after it has risen to the surface it is known as *gravity cream,* and the remaining portion is called *skimmed milk.* Gravity cream varies in strength, depending upon the length of time permitted for the fat to rise to the surface and the depth of the layer which is removed. Thus, if a quart of milk be allowed to stand for from three to four hours, the upper 11 ounces will contain approximately 10 per cent. of fat, while if the upper 16 ounces, or half of the quart, be removed, this superfatted milk or cream will contain about 7 per cent. of fat. Cream may be removed by the centrifuge (*centrifugal cream*). This cream is much richer, containing from 20 per cent. to 35 per cent. of fat.

The amount of fat in whole milk is not constant. Its variability has been noted in the different breeds of cows. Good milk averages about 4 per cent. The range of variability allowed by most milk commissions is between 3½ per cent. and 4½ per cent. Microscopically the oil globules of the fat of cows' milk are seen to be large (Fig. 7, II). The caloric value of the fat is 9.

The *protein* exists in solution as *calcium casein* (formerly caseinogen) and as *lactalbumin* and *lactoglobulin.* Other protein substances of less importance are present, but have no general practical interest. If cows' milk be acted upon by rennin or by the gastric juice in the presence of body temperature it coagulates into a solid mass. From this mass will exude a perfectly clear, colorless fluid, and the mass will contract into a tough curd. The colorless fluid is known as *whey,* and contains principally the so-called

*whey-proteins* or *soluble proteins*—*lactalbumin* and *lacto-globulin,* as well as the *salts of milk* and the *sugar of milk*—*lactose.* During the process of separating from the curd some little fat is carried along. Although, theoretically, whey should contain no fat, practically it does. The composition of whey is variously given by chemists. An average analysis follows:—

| | Per cent. |
|---|---|
| Protein | 0.94 |
| Fat | 0.96 |
| Lactose | 5.49 |
| Salts | 0.48 |
| Water | 92.13 |
| | 100.00 |

Thus it may practically be regarded as a 5 per cent. solution of milk-sugar containing 1 per cent. of whey-proteins and 1 per cent. of fat.

Lactalbumin and lactoglobulin constitute about one-third or one-fifth of the total protein. The former resembles serum albumin and the latter serum globulin.

The *coagulable portion* of the protein remaining is known as the *curd,* or *calcium paracasein* (formerly casein), and constitutes the large part of the albuminous content (about two-thirds or four-fifths). When coagulation occurs the curd, which is tough, leathery, and dense, contains within its meshes fat globules, some lactose, and mineral salts. The amount of combined protein, as the fat, is variable, but in good milk it averages about 4½ per cent. A variation of from 3 per cent. to 4 per cent. may be regarded as within the normal limits. The caloric value of the combined protein is 4.

*Lactose* constitutes the main *carbohydrate.* It is a disaccharid. It is readily changed to lactic acid by the lactic

acid bacillus. It crystallizes into hard, white prisms. It is less sweet than cane-sugar (weight for weight) and is soluble in 6 parts of cold water. It is not fermented by yeast. It reduces Fehling's solution. When acted upon by dilute mineral acids it is changed to dextrose and galactose. The lactose of commerce is obtained as a by-product in the manufacture of cheese by the evaporation of whey. It is identical in composition to the lactose of human milk, but it is unclean and requires sterilization. Cows' milk contains about 4 per cent. of lactose, which has a caloric value of 4.

The *mineral constituents* consist principally of the phosphate of potassium, sodium, calcium, and magnesium, together with the chlorids of potassium and sodium. Iron is found in less quantity than in human milk. It is in organic combination with nuclein. Milk contains about 0.75 per cent. of mineral matter.

**Bacteria.**—Some of the bacteria found in milk are pathogenic and others are not. Of the former the more common are the tubercle bacillus, the bacillus of typhoid fever, and the bacillus of diphtheria. Epidemics of scarlet fever have not infrequently been traced to a contaminated milk-supply. Local disease of the udder may cause the entrance of the different varieties of streptococci, staphylococci and more rarely of anthrax bacilli. The commoner non-pathogenic varieties found are those belonging to the lactic acid and the colon groups. The *total solids,* including fat, protein, lactose, mineral constituents and bacteria, average about 13½ per cent. The remainder is *water.*

The *microscopic appearance* shows the fat globules to be large and floating in an opaque fluid. Some epithelium and a few leucocytes may be present and are to be regarded as normal (Fig. 7, II). Any increase in these indicates

disease, usually inflammation of the udder, and renders the milk unfit for food. Bacteria are readily recognized by staining, or they may be seen in the fresh specimen. For positive identification they must be cultured, colonized, isolated, and stained.

**Sources of Adulteration and Contamination.**— Milk occupies the dual position of being the bottle babies' best friend and worst enemy. The latter is brought about by contamination and adulterations, either accidental or intentional. The initial source of contamination occurs at the time of milking, and one of the most important is the dust-laden air of the stable. Anyone who has ever visited a farm and watched the ordinary farmer milk his cows and then, when through, to see him strain it through a coarse strainer and then note that left in the latter are particles of straw, manure, dust, and hair, will be able to appreciate how readily milk may become a carrier of disease.

The cows are usually kept in poorly ventilated stables, in stalls provided only with straw beds, and with no means of collecting the manure, which becoming entangled in the straw and, drying, is thrown into the air, by the kicking and shuffling of the animal. Flies are not excluded, and the udder too is covered with dry manure and milk. The farmer does his milking into an open, perhaps unwashed, bucket or one rinsed in spring-water. The atmosphere is dust-laden and his hands are probably unclean. The cow may have an ulcerated, inflamed, or even tubercular udder. From his bucket the milk is placed into an indifferently cleansed can, after straining as indicated—the gross particles having been removed, but the micro-organisms all passing through. The cans are placed in the spring-house, in which the temperature, while low, is not sufficiently so to

prevent bacterial growth. Before being placed in the cans, if the farmer be unscrupulous, the milk may be watered or preservatives introduced, or chalk added to whiten it. It is now transported to the railway station, where it awaits the early train. In the mean time bacterial growth can continue. It reaches the city, where, on the unloading platform, it may be exposed to the sun for hours. This again favors the further development of micro-organisms. Exposure again occurs in the milk-house where it must be bottled, and, unless the establishment is run in a hygienic manner, the improperly washed bottles and the hands of the workmen may be a further source of contamination. In the early morning it is delivered on the doorstep of the consumer, where it remains exposed for a few hours to a gradually rising temperature, and in summer months to a very high degree of heat.

In the home the sources of additional infection are many. Danger may arise from improper icing, improperly sterilized receptacles, bottles, nipples, and the water used to dilute may be unfit for this purpose. The formula, even if properly made, may not be carefully iced, and bacterial growth continues uninterrupted. In some cases the milk is not bottled, but sold direct to grocery stores and thence to the consumer, being dipped from the can into a pitcher. Infection readily occurs in this manner. Milkmen have been seen to drink milk from the lid of the can while *en route* in the city streets, and to return what they did not want to the can. This, not alone filthy habit, is exceptionally dangerous in that the likelihood of tubercular contamination is imminent. Another unclean habit is for the mother or nurse to suck the milk from the nursing bottle in testing the temperature before feeding it to the baby.

It is readily seen, therefore, that from the time the milk leaves the cow until it reaches the consumer it is exposed to many and varied sources of infection.

**Analysis of Milk and Detection of Chemical Adulteration.**—Analyses for the various normal constituents of cows' milk are conducted as for human milk (Chapter I). The average composition of normal milk may be stated as follows:—

REACTION, AMPHOTERIC OR ACID.

| | |
|---|---|
| Specific gravity | 1029 to 1034 |
| Protein | 3.50% to 4.50% |
| Fat | 4.00% |
| Water | 4.00% |
| Mineral matter | .75% |
| Total solids | 12.25% to 13.25% |
| Water | 87.75% to 86.75% |

**Watering of Milk.**—Water is added to milk by dishonest dairymen and dealers, to increase the volume. Aside from the moral aspect of the procedure, this is a very dangerous practice. It dilutes the various chemical constituents, thereby destroying the nutritive qualities of the milk. Besides it adds to the milk millions of micro-organisms, many of which may be pathogenic. In the same class belong those cases where skimmed milk is sold for pure cows' milk. An easy and simple method of detecting these practices, aside from noting the physical character of the milk, is by the use of a small hydrometer. Skimmed milk, when allowed to stand, will collect no cream on the surface. It is paler than pure milk and has a higher specific gravity, because the cream, the lightest constituent, has been removed. Watered milk is pale bluish in color and of a low specific gravity. Milk may be both skimmed and watered at the same time, exhibiting a normal specific gravity. These adulterations can usually be detected with

the naked eye or are discovered by chemical analysis. For practical purposes the lactometer (ordinary hydrometer) is very convenient, and is a rapid means of detecting a good from a bad milk (Fig. 9, page 19).

**Preservatives.**—Preservatives are added to milk to keep it fresh, to prevent the growth of micro-organisms, and to save, to the dealer, the expense of extensive icing. Among the preservatives, formaldehyd is the most extensively employed. Boric acid, benzoate of soda, borax, bichromate of potassium, and salicylic acid are used, but to a much less extent. Chalk is added at times, to color the milk white after it has been watered.

*Formaldehyd* is usually employed in the form of *formalin,* which is a 40 per cent. solution of formaldehyd gas in water. Only a few drops of this solution need be added to a pint of milk to keep it sweet. Formalin is rarely added in sufficient quantity to be tasted. It may be detected by two principal tests: (*a*) Dilute a small quantity of milk with an equal amount of water. Pour this gently upon some strong sulphuric acid in a test tube. If formaldehyd be present, there will appear a violet color at the line of contact. If formaldehyd be absent, a greenish or brownish ring will be formed. Hydrochloric acid causes the casein of milk to appear yellow in the presence of formaldehyd.

(*b*) Distil a small quantity of milk and to the distillate add a drop of a weak solution of carbolic acid in water. Gently pour this over some strong sulphuric acid. If formaldehyd be present a red ring is formed at the line of contact.

*Borax* and *boric acid* are detected, qualitatively, in the following manner: (*a*) A small quantity of milk is diluted with an equal amount of distilled water, and then slowly

evaporated to dryness. The residue is shaken with alcohol and filtered. The filtrate is then ignited and burns with a green flame.

(*b*) If a piece of tumeric paper be immersed in a solution containing boric acid, upon drying it turns to a reddish-brown color.

To detect *salicylic acid* mix a small amount of the suspected milk with an equal quantity of water. Add a few drops of acetic acid, and apply gentle heat to the boiling point, but do not boil. Add an excess of pure mercuric nitrate. The casein is coagulated. Filter. Evaporate the filtrate. Agitate the residue with ether. Evaporate the ethereal extract. Touch the residue with a few drops of tincture of ferric chloride. If salicylic acid be present there occurs a violet color.

*Potassium bichromate* may be detected by coagulating the milk with a few drops of acetic acid and gentle heat. Filter. To the filtrate add a few drops of a solution of lead acetate. A yellow precipitate of lead chromate indicates the presence of the preservative.

Milk containing *chalk* is alkaline in reaction and effervesces upon the addition of hydrochloric acid, setting free carbon dioxid gas. The crystals of calcium carbonate may be detected by the microscope.

**Hygienic Care of Cows.**—While not attempting to deal with this subject in the comprehensive manner which it merits, a work of this kind that failed to emphasize the great importance of it would be incomplete. All cows should be tested with tuberculin and mallein. The cow-barns must be made sanitary. The stalls must be kept clean and free of all dust and manure. The food must be selected and clean and regularly given to prevent indiges-

tion. The animals should be regularly watered. The udders are to be kept clean, especially before milking, which should be done in a separate dust-free room. Plenty of rest, and exercise in the green pasture are essential. Under no circumstances should the cows be frightened or teased. In winter they are to be housed in such a manner that they do not suffer from cold.

**Collection and Care of Milk for Marketing.**—Cows must all be free from tuberculosis and glanders. The cow-stable should be well ventilated. The floors should be boarded. The cows should be curried and groomed daily. The fecal and urinary discharges should be removed from the stall at once. Attendants should be free of disease, and scrupulously clean in person and of good disposition. Persons who have just recovered from typhoid fever should not be employed. Privies and urinals receiving human excrement must be far removed from the cows or the milk-room. If possible the milking should be done in a separate compartment, into which the cow is taken after the udder has been thoroughly cleansed with soap and water, rinsed and dried. The milker's hands are prepared by thorough scrubbing and immersion into an antiseptic solution. The milking is done into the spout of a covered can upon which the milker sits (Fig. 16). In the spout is a metal filter. Previous to use, the can, and especially the filter, should be scrubbed with soap and water, rinsed, and scalded with live steam. The milk is at once carried into the cooling room, where it is placed into a special, previously sterilized cooling apparatus, which permits it to flow into sterilized quart bottles. The bottles are closed with sterile caps and at once iced. The milk has not been touched by human hands and has reached a refrigerating temperature within half an hour after leav-

ing the cow's body. It is shipped to the city iced and kept so until it reaches the door of the consumer. This it should do in not less than twenty-four hours. It may even be delivered iced in small individual boxes.

**Care of the Milk in the Home.**—On the doorstep of the consumer great damage may often be done to the very cleanest milk. What organisms have entered at the time of milking may rapidly increase if the bottle be permitted to remain long exposed to the sun. It should be immediately

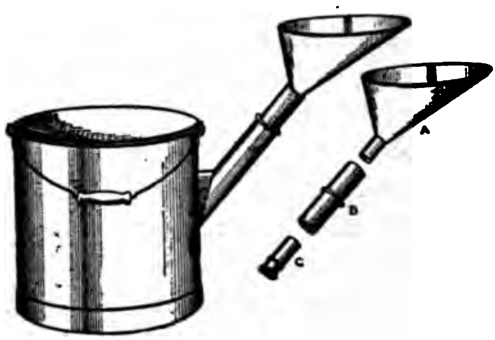


Fig. 16.—Proper can used in milking cows. (Dairyman's Supply Co., Philadelphia, Pa.)

taken into the house and iced until needed. When making modifications every possible means of cleanliness and sterilization with reference to apparatus and diluents should be carefully managed, otherwise a perfect milk may become contaminated. After the formula has been made, careful and continuous icing are essential. In other words, the requirements necessary to secure a good milk, aside from its proper hygienic care in the home, are perfect dairy hygiene and healthy cows, quick refrigeration and shipment to the city, or, as someone has said, it is important to "shorten the time between the cow and the baby."

# PLATE VI

Constipated, greasy stool of artificially fed infant. This stool is due to the administration of too much fat. It is foul-smelling (like Limburger cheese), and is commonly accompanied by a stationary weight and an ammoniacal urine. Reduce or omit the fat in the formula or practice the other methods for treating fat intolerance. (See text.)

Clean milk is an essential to successful infant feeding, and it matters not how well may be adjusted the percentage or caloric requirements of the food, it will not only fail in its purpose, but it will accomplish serious damage as well, unless this is actually secured.

Consumable milk as marketed today may be readily classified under three types:—

## ORDINARY MILK, NURSERY MILK, AND CERTIFIED MILK.

**Ordinary Milk.**—This is milk that is sold from cans in the shops, or from wagons, or may be bottled at the city distributing station after shipment in large cans. It is constantly exposed to contamination and is scarcely a fit food for infants. The bacterial count is high. It should never be given unboiled. It sells for 8 cents a quart in Philadelphia.

**Nursery Milk,** so called, represents an attempt to produce a higher grade or cleaner milk. It is bottled on the farm and usually contains a smaller number of bacteria than ordinary milk. It should never be fed unpasteurized or unsterilized. It costs about 12 cents a quart.

**Certified Milk** represents an attempt at the production of a perfectly clean milk. Coit, of Newark, was the first to conceive the idea of a milk commission in conjunction with the County Medical Society, or independent of it. The milk commission has in its employ a chemist and a bacteriologist whose duties are to visit the dairy of anyone who may enter into an agreement with the commission. At stated, but unannounced, intervals the chemist and bacteriologist inspect the dairy and examine the milk. If it be up to the standard as decided upon by the milk commission,

the dairyman receives a certificate—hence *certified milk,* which simply means the purest and most wholesome milk obtainable. If the requirements are not met the certificate is withheld, after giving the dairyman ten days in which to correct the error. The milk commission requires perfect dairy hygiene and demands a certain bacterial standard. This has not been uniform with all commissions, some allowing 10,000 bacterial colonies[1] and some 20,000 or more per cubic centimeter. The American Association of Medical Milk Commissioners has adopted 10,000 as the maximum number allowed. As far as possible the nature of these organisms should be determined, as the presence of a few pathologic ones (typhoid fever, for example) would do more damage than many non-pathogenic bacteria. In order to keep the number as low as possible the milk must not be over 30 hours old before it is received by the consumer.

Besides the bacteriologic requirements, the milk must contain not less than 3½ per cent. of fat and preferably 4½ per cent.; cream not less than 18 per cent. From 3 per cent. to 4 per cent. of protein must be present. There must be no preservatives, and the specific gravity is required to be between 1029 and 1034.

The commission also supervises the health of the employés.

It will be seen, therefore, that the cost of production of certified milk is greater than under ordinary circumstances. For this reason this milk sells from 16 to 24 cents a quart.

"May certified milk be fed raw?" is a common query.

---

[1] The terms "bacteria" and "bacterial colonies" are commonly used interchangeably. This is an error, as the colonies are counted and not the bacteria. This distinction is important, as it can be readily appreciated that there is quite a difference between 10,000 *bacteria* and 10,000 *bacterial colonies.*

Theoretically it should be perfectly safe and is so during eight months of the year. During June, July, August, and September, in order to make assurance more certain, it is recommended that even certified milk should be pasteurized or sterilized in the home.

## HOW COWS' MILK DIFFERS FROM MATERNAL MILK.

The proper adaptation of cows' milk entails a knowledge of the biologic, chemical, and physical differences between it and human milk.

The *reaction* of cows' milk to litmus-paper is *amphoteric* or *acid*. By the time it reaches the consumer it is acid, owing to the formation of lactic acid. That of human milk is *amphoteric, leaning toward alkaline*. The *specific gravity* of cows' milk is 1029 to 1034, that of human milk 1031. The greatest difference between these two milks is in the *character* and the *quantity* of the *protein*. When cows' milk is acted upon by rennin or pepsin, at body temperature, the coagulable portion (calcium paracasein) derived from calcium casein (caseinogen) clots in large, lumpy, tough curds. The liquid portion contains lactalbumin and lactoglobulin. It has been shown that the calcium casein of human milk is changed by rennin into fine, flaky curds of calcium paracasein. The amount of combined protein found in cows' milk equals about 4.5 per cent., two-thirds of which is coagulable by rennin. The total amount in human milk is 1.5 per cent., of which but one-fourth is coagulable by rennin. The fats existing in the two milks are about equal in amount, but those of cows' milk are more volatile and irritating. There exists in cows' milk only about one-half as much lactose. Cows' milk is *practically never sterile*. It may be sterile in the cow's udder, but as

soon as it strikes the air or the surface of the teat it becomes contaminated. It also receives micro-organisms from the hands of the milker, sores upon the udder, the milk cans and, sometimes, from the water which is added to dilute the milk by dishonest dealers. The organisms gain entrance into the milk by the medium of flies, stable dust, and manure. They may be pathogenic or non-pathogenic, depending upon their source. They multiply rapidly and may equal 20,000,000 colonies per cubic centimeter. They constitute a dangerous factor when cows' milk is employed as an infant food, playing an important rôle in the production of the summer diarrheas and other gastrointestinal complaints. The following table shows the differences detailed above:—

| Cow's milk. | | Human Milk. |
|---|---|---|
| Amphoteric or acid | Reaction | Alkaline. |
| 1029 to 1034 | Specific gravity | 1029 to 1031. |
| 4.5% | Proteins | 1.5 to 2%. |
| Clots in large lumpy curds. | Effect of rennin. | Clots in fine curd. |
| 4.0 % | Fats | 3.50 to 4%. |
| 4.0 % | Lactose | 6.0 to 7%. |
| 0.75% | Salts | 0.20 to 1%. |
| 13.25% | Total solids | 11.20 to 14%. |
| 86.75% | Water | 88.80 to 86%. |
| Never sterile | Bacteria | Practically sterile. |

## THEORY OF MILK ADAPTATION.

The term "milk adaptation" is better than "milk modification" for the reason that it at once defines the principle upon which the problem of infant feeding and of milk manipulation rests, viz., *individualization*. A successful feeder of infants must individualize and not feed by rule of thumb. The importance of this one's or that one's method of feeding is fast disappearing in so far as it would describe a fixed way of feeding *all* infants. As a means

toward an end, any method that will permit of the manipulation of milk, so that it will fit the requirements of the individual infant, will live and continue to be a means of considerable help. One *may not* feed an infant *percentages of fat, protein, and lactose suitable to its age* on *calories* said *to be required by its weight,* but one *must feed percentages of these ingredients that it can digest* and *calories that will cause it to gain in weight*—whether these be less or more than the fixed requirements. The best judge of the suitability of any formula is the infant itself. If it exhibits a continuous and regular gain in weight and has a good digestion (normal stools and little or no vomiting), that is the correct formula for it regardless of its composition as to quantity or quality. The *weight* and the *digestion* are, therefore, the guides as to the suitability of any food for the individual.

The first formula prescribed by the most eminent dietitian is an experiment. We may start out with the idea that we wish to give an individual baby, say, 2 per cent. of fat, 6 per cent. of sugar, and 1½ per cent. of protein, and we proceed to calculate this in ounces of milk, cream, sugar, and water. "Is there absolute accuracy of these various percentages in the finished product?" We do not know. The chances are against it. Any one of the various ingredients may, and probably does, vary from one-fourth to one-half of 1 per cent. too much or too little. *The feeding of absolutely accurate percentages is impossible and unnecessary.* Any conception of percentage feeding that regards this as one of the possible advantages to be gained is fallacious and mischievous. *What percentage feeding should mean and afford is an easy way whereby any one of the ingredients of the formula—fat, protein, or*

*sugar—may be increased or diminished, and it is the physician's province to determine which of these is at fault by studying the symptoms of the individual.* What these symptoms of the different forms of indigestion are will be stated under their respective headings. Recognizing that element which is at fault, the physician simply applies whatever method of milk adaptation he may favor to the case, and increases or diminishes the ingredient, using the figures which represent percentages simply as a guide, not caring whether those figures accurately represent the exact amount or not. One cannot say that the fat of cows' milk is the cause of all digestive disturbances in infancy, any more than one can proclaim that infants will tolerate incalculable amounts of the curd of cows' milk; nor can one lay all digestive disturbances to protein or to sugar, or to excessive calory feeding. One cannot affirm that all infants must be fed every two hours, nor yet every four hours, nor that quantities must be regulated by set figures for the age. Here again it is necessary to individualize and to be guided by the digestion and the appetite.

A glance at the foregoing table will indicate certain intrinsic differences between cows' milk and human milk, and it appears patent that these must be considered in any scheme that would provide nourishment for the individual baby. The most striking feature is that, as it exists in its native state, the *protein* of cows' milk exceeds in amount by about three times that found in human milk, and differs intrinsically in the nature of the curd. Any system of feeding that does not recognize this as an indication to feed to an infant in its early weeks, an amount of cows' curd less than that found in human milk, and at the same time to change its physical character, must necessarily fail. Milks

are suited to the species, and it is undoubtedly true that the curd determines the future character of the gastrointestinal tract and prepares it for the food which it will receive in adult life. Intestinal development, therefore, depends upon the nature of the curd (Chapin). The curd of cows' milk is intended to develop the gastrointestinal tract of a calf into that of a cow, and therefore is suited to the digestion of a calf, while that of human milk is intended to develop the guts of an infant into those of a man, and is therefore suited to the digestive powers of early life. Hence the cows' curd must be fed in small amounts at first and modified in nature, either mechanically or chemically, until tolerance is established. The extent of this modification again depends upon the digestive capacity of the individual, some infants at an early age being able to tolerate larger amounts of protein than others which are older.

The curd of bovine milk may be dealt with in several ways. The processes employed will be described later, they simply being named here. In the first place the coagulable protein (calcium paracasein) may be eliminated entirely by the feeding of whey in instances wherein protein intolerance exists. The curd may be attenuated, *i.e.*, be made to coagulate in the stomach in finer flocculi by the use of cereal waters or gruels,—plain (Jacobi) or dextrinized (Chapin),—flour ball, or by malt soup. It may further be acted upon so as to pass through the stomach without coagulation by the addition of sodium citrate (Poynton). Predigestion, or pancreatization, and sterilization are other means of rendering the curd digestible. Lastly, mechanical division of the curd may be secured by feeding Finkelstein's eiweissmilch or buttermilk.

Unchanged cow-protein is therefore fed in gradually

increasing amounts until a quantity is reached that about equals or slightly exceeds that found in human milk. One must always, however, be guided by the digestive powers of the individual. By the time the infant reaches 9 months or a year it may receive, if it be healthy, whole cows' milk, which means about 4½ per cent. of combined protein. I have met a few instances in which this was safely tolerated at 5½ months.

While occurring in about the same amounts, in both human and in cows' milk, it is nevertheless true that the *fat* of the latter is less easy of digestion. The same rule, applicable to the protein, therefore applies here. The amount of fat fed must be gauged by the individual's ability to appropriate it. It is best to start with small amounts and to gradually increase, as a rule never exceeding 4 per cent. In most instances infants do better if kept within this amount—from 2½ to 3½ per cent. Certain infants cannot tolerate fat at all. These must be fed skimmed milk, buttermilk, eiweissmilch, or the formula may be pancreatized. The necessity for fat, however, is urgent, as it provides heat and energy and conserves the proteins of the body. As this is also done by the carbohydrates, in instances wherein fat intolerance occurs, the deficiency may be made up by the addition of starches and sugar.

The *carbohydrates* of these two milks are identical in chemistry, but differ in amounts. The milk-sugar of commerce requires sterilization. How are we to deal with the carbohydrates? Personal experience would conclude that infants bear sugar well. Physiologically this is substantiated by the high sugar content of human milk. Sugar provides heat and energy. The German idea that milk-sugar, *per se,* is responsible for the initiation of all cases of

summer diarrhea appears to be overdrawn, although the withdrawal of sugar in the presence of summer complaint undoubtedly does good. So long as micro-organisms infest milk, so long will their rôle, either by causing toxic changes in the milk itself or in the intestines of the infant, be quite potent.

Milk-sugar is not the best carbohydrate to add to milk, for the reasons stated, that it is unclean, and because it requires sterilization and readily ferments. For years Jacobi advocated cane-sugar, which is cheaper, cleaner, more easily accessible, and ferments less readily. Its use is attended by very little digestive disturbance, and has given universally good results. Least irritating of all sugars, and more readily digested and quickly absorbed, is maltose. It is added in about the same amounts as the other sugars (Chapter III, page 137). Immediately after birth, most infants can tolerate from 4 to 5 per cent. of sugar. This usually may be speedily increased to 6 or 7 per cent. and at about 9 months is gradually reduced until at a year 4 per cent. is reached. This guide may require variation, as the individual digestion may indicate. Those infants which bear sugar badly may be fed upon simple dilutions of whole milk, without the further addition of carbohydrate, or upon buttermilk or eiweissmilch. If the absence of sugar makes the food unacceptable to the infant, the sweet taste may be supplied by the addition of saccharin, 1 grain to the quart. Every ounce of sugar equals about 120 calories.

Cows' milk is deficient in those *mineral substances* in which human milk is rich. To this latter quality and to the *antibodies,* derived from the mother, human milk probably owes its *antiscorbutic, antirachitic,* and *immunizing* qualities. In the artificially fed it is necessary to make up for

these deficiencies by feeding to the infant, between nursings, fruit-juices and beef-juice. These are rich in organic substances and materially increase the content of chlorid of soda. This has a stimulating effect upon the gastric secretion, thereby aiding digestion. It is good practice to add a few grains of common salt therefore to each bottle as well (Jacobi). This has been my personal practice for years.

Human milk is *sterile;* cows' milk *is not.* This difference must be overcome by securing as clean a milk as is possible. This is accomplished by using certified milk or by pasteurization or sterilization (pages 91-94).

The *reaction* of cows' milk by the time it reaches the consumer is often *acid. Alkalies* are to be added with a purpose in view, but not routinely. Sodium citrate, sodium bicarbonate, and lime-water are employed. Their special indications will be detailed as we proceed.

**Summary.**—The various percentages of fat, protein, and lactose, as well as the caloric requirements, are to be adapted to the individual. In addition, animal and vegetable juices are necessary. Micro-organisms must be eliminated or destroyed. Alkalies may be required.

## METHODS OF MILK ADAPTATION.

**Percentage Feeding.**—The various methods of adapting cows' milk to the needs of the infant have multiplied so rapidly that considerable confusion exists as to which is the best. Having stated the basic principle of percentage feeding, it follows that any method will be suitable that affords an easy means of increasing or diminishing the ingredients of the milk. Two ways of handling this problem are open to practitioners of American cities—the Laboratory Method and the Home Method:—

**Laboratory Method.**—This is the easiest from the practitioner's viewpoint, and yet in practice is the least satisfactory. The physician studies his patient's needs, and writes the percentages of the different elements in the milk as he determines will supply those needs and be acceptable to his patient's digestion. The prescription also states the number of feedings and the amount of each feeding, together with the nature of the diluent. This is sent to the laboratory. The completed formula, either in a single container or in individual bottles, containing sufficient food for one feeding, properly iced, is delivered to the patient's home each day. The physician may change his prescription at any time. Laboratories have been established in many of the large cities in America by the Walker-Gordon firm, under the impetus given accurate percentage feeding by Rotch, of Boston. The disadvantage of this method is that it is not available in rural districts. It is costly and beyond the reach of the middle classes and the poor, who most need clean milk. Further, as good results, and perhaps better, can be obtained by careful home modification.

The following represents a prescription form that may be used in laboratory feeding:—

Name .......................... Age ..........................
Address .......................... Date ..........................
℞ Protein .......................................... %
Fat .......................................... %
Sugar .......................................... %
Alkali .......................................... %
No. of feedings .................. Amount of each feeding ........
Character of diluent .............. Maltose, saccharose, lactose ......
Lime-water ...................... Pasteurize?
Sodium bicarb. ..............................................
Sodium citrate ..............................................
.......................... M.D.

**Home Method of Milk Adaptation.**—That system of milk modification or, better, of milk adaptation is correct which gives correct results. The simpler the means by which good results are obtained, the better is the method; for it is more readily adopted by practitioners, is more easily taught to the mother, and is best for the infant. It has therefore appeared to me, after fifteen years of experience with nearly all the methods proposed, *that the simple dilution of whole or of skimmed or of partly skimmed milk will yield as good results as the use of top-milks or of those formulæ derived from some highly complicated algebraic equation.* By means of the simple dilution of whole or of skimmed milk we need not, nor indeed we should not, discard the percentage nor even the caloric idea. Both are founded upon sound scientific reasoning, and both are of use provided they do not cause one to become narrow and dogmatic. Percentages should simply be regarded as representing certain degrees of strength, and the numbers employed to represent the percentages should never be considered to mean absolutely the exact amount of fat, sugar, or protein, as the case may be, as is stated. This is impossible; likewise it is unnecessary. The numbers employed to represent percentages might just as well be indicated by a letter. Thus P. 1 per cent. and P. 2 per cent. could be written P*a*, P*b*, each advancing letter standing for a degree of strength of protein stronger than the preceding letter. The same applies to the varying strengths of fat and of sugar which may be desired. The idea is not to feed accurate percentages of each ingredient, but to have a means of increasing or of diminishing any particular substance which the clinical condition may indicate. The same is true with reference to the caloric requirements of the individual. Any

formula may be checked, and thus one will be able in the individual case to note whether the particular baby is receiving a sufficient number of heat units.

From the foregoing it must be realized that without the use of common sense one need not expect to become a successful feeder of infants. The keynote of the whole situation is that the individual must be studied from the standpoints of his appetite, his strength, his caloric requirements,—above all, from the standpoint of his digestive capabilities. He who would be successful must therefore be a good reader of stools, and must be able to interpret the macroscopic appearance of the excreta properly, and to determine the individual's ability to take care of the fat, sugar, and protein. These points have just been detailed on pages 32-34. It may, however, again be emphasized that the main indices as to the value of any particular food are a *continuous and substantial weekly gain in weight and normal stools.* If the latter are present and the infant is receiving a sufficient quantity of food, the former must follow as a natural consequence. It is inevitable. Therefore the first formula would be written about as follows:—

| | |
|---|---|
| Skimmed milk | 2.5 oz. |
| Diluent | 17.5 oz. |
| Sugar | 1.0 oz. |
| Salt | 1 pinch. |

As stated previously, this is an experiment, as all first formulæ are, even in the best of hands. Upon this the infant may not immediately gain. Skimmed milk is employed in the beginning simply to "play safe." Fat is a common disturber of digestion, and therefore, at the outset, fat is temporarily omitted or reduced to a minimum. Our guides —the stools and the weight—are now consulted. As just

stated, one would not as yet expect a gain. However, it is assumed that the stools appear normal and that the infant does not vomit. We now proceed cautiously. We employ half-skimmed milk in the same proportions as we employed the wholly skimmed milk. The mother is instructed to remove all the cream, and then to pour back into the bottle half of that which was removed. The whole is well shaken up and the second formula is made up as follows:—

| | |
|---|---|
| Half-skimmed milk | 2.5 oz. |
| Diluent | 17.5 oz. |
| Sugar | 1.0 oz. |
| Salt | 1 pinch. |

It is again assumed that this slight addition of fat causes no disturbance. In a day or two the mother is instructed to shake up well the whole quart of milk and to employ a formula as follows:—

| | |
|---|---|
| Whole milk | 2.5 oz. |
| Diluent | 17.5 oz. |
| Sugar | 1.0 oz. |
| Salt | 1 pinch. |

No disturbance occurring, in daily succession we speedily change the formula as indicated: —

| | |
|---|---|
| Whole milk | 4 oz. |
| Diluent | 16 oz. |
| Sugar | 1 oz. |
| Salt | 1 pinch. |

And then too:—

| | |
|---|---|
| Whole milk | 5 oz. |
| Diluent | 15 oz. |
| Sugar | 1 oz. |
| Salt | 1 pinch. |

From this point onward if the digestion be good the baby should commence to gain from ¾ to 1 ounce a day or from 5 to 7 ounces per week. The questions to be answered now

are: "When shall the strength of the formula be changed again?" and "When shall the amount of each feeding be increased?" The safest rule to follow in my own experience *is to make no change until the infant ceases to gain on its food. Let a stationary weight or a slight loss therefore be our index for action in a case that has been continuously gaining and digesting well.*

We may now do one of three things, viz., (*a*) Increase the strength of the milk in the formula. (*b*) Increase the amount of each feeding. (*c*) Do both.

The last is bad practice. It is unwise to increase the amount of the feed when the strength of the formula is increased, *i.e.*, it is bad to do both simultaneously. The latter should be done a day or two after the former, when it is seen that the increase in the strength of the formula has caused no disturbance. "What should be the size of the increment in the milk content of the formula?" and "What should be the size of the increment of the bulk of the meal?" The latter will be answered first. The *quantity* added to each meal should never exceed 1 ounce, and it had better be not more than ½ ounce. Thus, if 10 meals were given daily, this would mean the increase of from 10 to 5 ounces in the total bulk of the food per diem. The *strength of the formula* may be increased as follows, meanwhile making daily inspections of the stools:—

| | |
|---|---|
| Whole milk | 6 oz. |
| Diluent | 14 oz. |
| Sugar | 1 oz. |
| Salt | 1 pinch. |

| | |
|---|---|
| Whole milk | 7 oz. |
| Diluent | 13 oz. |
| Sugar | 1 oz. |
| Salt | 1 pinch. |

| | |
|---|---|
| Whole milk | 8 oz. |
| Diluent | 12 oz. |
| Sugar | 1 oz. |
| Salt | 1 pinch. |

And so on, the guide to change from one strength to a higher concentration meanwhile being a cessation in the continuous weekly gain, as previously stated.

Weighing should never be practised oftener than twice weekly, and preferably but once weekly, for the reason that too frequent weighing causes discontent, disturbs the mother, and is likely to warp the physician's good judgment, thereby causing him to make changes in the food too frequently.

Thus this method of increasing the strength and then the size of the meal is persistently pursued toward the end, until the infant receives whole undiluted cows' milk. This is the goal. "When is this reached?" is a pertinent question. Not meaning to give an asinine answer, the best reply in my experience is that it is reached "when it is." The idea intended to be implied is that there can be no definite age limit. The digestive capabilities of the individual can alone determine this point. It may be at 6 months, slightly before, or not until 9 months or 1 year. The individual's digestive capacity can only be determined by cautiously proceeding according to the method indicated, of replacing an ounce of diluent by an ounce of milk and then slightly increasing the size of the meal and watching the effect. If this be for good, advance is made by employing the next stronger formula. If it disturbs the digestion we return again to the formula immediately preceding, or to a still weaker one, or we may adopt one or another of the maneuvers described in fat, sugar, or protein intolerance, as the case may be.

# PLATE VII

Hard, constipated, calcium-soap stool. Commonly seen where too much fat is administered in the formula. The fatty acids combine with the mineral substances contained in the intestinal mucus, which is increased as a result of the irritating effect of these acids. For this reason the passage of this constipated movement may be accompanied or followed by loose material. These babies either remain stationary or lose in weight, and often have an ammoniacal urine. For treatment, see text on fat intolerance. This stool is also of good prognostic significance in cases of diarrhea which have been placed upon buttermilk or eiweissmilch, the calcium casein of these preparations combining with the fatty acids, producing the caseate of lime or calcium-soap stool. When this is secured a return may be made to diluted-milk formulas.

If at any time during the course of a feeding case it is deemed necessary to determine the percentage strength of the formula which the infant is receiving, or to note its caloric value, this can readily be accomplished roughly with reference to the percentage of fat, sugar, and protein by regarding cows' milk as a "four, four, four mixture," that is, F. 4 per cent., L. 4 per cent., P. 4 per cent.

*Example:*—

| | |
|---|---|
| Milk ........................................ | 5 oz. |
| Diluent ........................................ | 15 oz. |
| Sugar ........................................ | 1 oz. |

Fat = $\frac{5}{20} = \frac{1}{4}$. $\frac{1}{4}$ of 4% = 1%.

Therefore, since each ingredient equaled 4%, we would have F. 1%, L. 1%, P. 1%. To this however 1 ounce of sugar has been added; therefore, as 1 ounce in 20 equals $^1/_{20}$ or 5% extra carbohydrate, this is added to the 1% obtained originally from the milk. Consequently, the total carbohydrate equals 1% plus 5%, or 6%. The final formula consequently would read:—

F. 1%, L. 6%, P. 1%.

*Rule to Determine the Percentage Strength of any Formula of Diluted Whole Milk.*—Divide the number of ounces of whole milk used by the number representing in ounces the total bulk of the mixture. Multiply the resulting fraction by 4. To the result obtained with reference to the sugar add the result secured by dividing the number of ounces of additional sugar by the number representing in ounces the total bulk of the formula, and multiply this by 100. Add this number to the number obtained with reference to the sugar percentage.

The *caloric value* of the mixture is readily determined by multiplying each ounce of milk by 21 and each ounce of

sugar by 120 and by adding these together. Of course if the mixture totals 40 oz. and if in twenty-four hours the child receives, say, but 30 oz. of this, then the total number of calories actually received by the child in twenty-four hours represents $^{30}/_{40}$ or 3/4 of the total number of calories represented by the entire formula. (See next page.)

It will be noticed that all of the formulæ preceding are calculated in total amounts of 20 ounces. This has been adopted merely as a matter of convenience and of habit. If the total daily quantity of formula equals 25, 30, 35, or 40 ounces, then each ingredient in the 20-ounce formula must be multiplied by 1.25, 1.50, 1.75, or 2 as the case may be.

The sugar which is added is, for practical purposes, disregarded as far as its influence upon increasing the total volume of the formula is concerned. It must be further stated that, as the concentration of the formula increases and approaches the strength of 3/4 milk and 1/4 diluent, the sugar is gradually decreased by 1/4 ounce amounts in the 20-ounce mixture until it is finally omitted.

**Calory Feeding.**—This is a method of feeding based on the caloric requirements of the infant as determined by its weight. An infant up to 6 months needs approximately about 100 calories per kilogram of body weight, or about 45 calories per pound. As the child approaches a year the caloric requirement is somewhat less—between 85 and 80 calories per kilo, or 32 to 35 per pound.[1] These figures

[1] The exact figures given by Heubner and Rubner are as follows:—

| | |
|---|---|
| First 3 months | 100 calories. |
| Second 3 months | 90 calories. |
| Third 3 months | 80 calories. |
| Fourth 3 months | 70 calories. |

have reference to healthy infants. Some undernourished or premature babies require as high as 125 to 175 calories. One quart of cows' milk equals 680 calories. One quart of human milk equals 615 calories. Allen has concluded that, in order to maintain nitrogen equilibrium, it is necessary for the infant to receive the protein contained in 1 ounce of cows' milk for every pound of body weight. Therefore if it be desired to provide for body growth and development in addition, it is necessary to give from 1½ to 2 ounces of cows' milk for every pound of weight. Hence, to determine how much milk is to be employed in the formula, the weight is multiplied by 1½ or 2. This result is deducted from the total quantity of food required in twenty-four hours in order to learn the amount of diluent necessary. Any deficiency of caloric value is made up by adding carbohydrate in the form of lactose, saccharose, or maltose, preferably the last two. One ounce of all sugars by weight about equals 120 calories. One ounce of 4 per cent. milk approximates 21 calories.

*Example.*—A healthy infant 6 months old weighs 15 pounds and is receiving 7 ounces of food six times a day. Total quantity in twenty-four hours equals 6 multiplied by 7, or 42 ounces.

$15 \times 45 = 675$ calories required in twenty-four hours.
$15 \times 1.5 = 22.5$ oz. milk.
$42 - 22.5 = 19.5$ oz. of diluent.
$22.5 \times 21 = 472.5$ calories provided by the milk.
$675 - 472.5 = 202.5$ calories, which can be supplied approximately by 1.75 oz. of sugar $= 210$ calories.

The infant therefore receives $472.5 + 210 = 682.5$ calories.

*Advantages of This Method.*—Its simplicity at once appeals. All that is necessary is to multiply the infant's

weight by 1.5. Add sufficient diluent to bring up the bulk of the food to the twenty-four-hour requirement and sufficient carbohydrate to raise the caloric value to the weight requirement. As a check upon percentage feeding it is valuable in that it permits the physician to know whether he is feeding under or above the food tolerance for the individual.

*Disadvantages of This Method.*—It does not take into consideration the strength of the food. Thus an infant of 3 months weighing 7 pounds would receive a much weaker mixture—as the total amount of food would be greater—than an infant of 1 week weighing 7 pounds. In the latter instance the strength of the food would probably be too great, as the total daily bulk would be less, and therefore the milk would not be sufficiently diluted.

Caloric feeding completely ignores the digestive capacity of the individual baby, taking cognizance alone of the heat units required. Further, in order to receive the number of calories necessary, the entire amount of the milk mixture provided for twenty-four hours must theoretically be consumed within that space of time. As a practical proposition this is often impossible, due to the vagaries of the infant's appetite as well as to other unpreventable causes.

Experience seems to show that in order to make the baby gain in weight it is necessary to provide more calories than 45 per pound of body weight. Often one and one-half and even twice this number must be given. If one adopts calory feeding as his method of nourishing infants, he may become as dogmatic in his statements as one who adheres entirely to percentage feeding. In order to be successful it is necessary to individualize as in any other method.

In ordering a milk mixture, whether percentage or calory, the following form has proved to be useful when handed to the child's caretaker.

Name ............................ Date ............................<br>
Weight ............................ Age ............................<br>
Fat ..................per cent. Sugar ..................per cent.<br>
Protein ...............per cent. Daily Amount ..................<br>
(Make fresh daily.)<br>
Calories required ..............................................<br>
Milk ............................................ oz.<br>
Skimmed milk ................................... oz.<br>
Cream ........................................... oz.<br>
Whey ........................................... oz.<br>
Barley-water ................................... oz.<br>
Oatmeal-water ................................. oz.<br>
Boiled water ................................... oz.<br>
Rice-water ..................................... oz.<br>
Lime-water ..................................... oz.<br>
Sugar ........................................... oz.<br>
Salt.<br>
Medicine { Soda cit. ......................................<br>
Saccharin ......................................<br>
Other ..........................................<br>
Pancreatized ................minutes.<br>
Feed ............oz. every ...........hours, giving ...........oz. in twenty-four hours.

**Diluents.**— Of the diluents employed with cows' milk, *water* probably enjoys the largest field of usefulness. Aside from its diluting properties, it is a valuable therapeutic agent when used intelligently. It is essentially a food and is necessary for the digestion and assimilation of all other foods. Without it the physiologic activity of the economy would cease. It not only allays thirst, but in physiologic quantities, administered regularly, it increases the flow of gastric juice. It renders soluble the salts of the gastric contents and prepares them for absorption. By increasing the fluidity of the intestinal contents it acts as a laxative and prevents constipation. It dissolves and dilutes

toxins, favoring their elimination through the skin and kidneys. It maintains blood-pressure. It forms the main component part of every secretion and excretion of the body. It favors the deposition of fat.

As a diluent therefore in milk mixtures it forms an invaluable addition as a nutritive agent. While its action is to dilute all the ingredients of the milk, it does not, to any considerable extent, change their physical characters. The curd formed by rennin with milk, diluted with water, is almost as tough and dense as that obtained with undiluted cows' milk.

To overcome this Jacobi, many years ago, first devised the use of *cereal decoctions,* for which he claimed the power of mechanically dividing the tough curd of cows' milk into a fine, flocculent, porous curd. For this purpose he recommended the use of barley-, wheat-, oatmeal-, and rice- water. Barley-, wheat-, and rice- water are to be employed when diarrhea exists, and oatmeal-water is added as a diluent with constipated children.

*Dextrinized gruels* are advocated as a diluent, especially by H. D. Chapin and Keller. They go a step farther in the use of plain cereal decoctions. Instead of using the plain cereal-water or thin gruel, they submit the latter to the action of some diastatic agent, thereby changing the starch to dextrin.

The efficacy of dextrinized gruel, made from wheat-flour, has been tested in a number of feeding cases in the Medico-Chirurgical and in the Philadelphia General Hospitals. It was added to the milk mixture, as a diluent, in the same amount as the formula called for water, the gruel taking the place of water. The first case did remarkably well, the child gaining in weight on an average of 1½

ounces a day, curds disappearing from the stools, which became normal in appearance. Other children, all infants under 1 year of age, showed varying results. Some grew fat and strong, others showing no change either in weight or in the character of their stools. In the test-tube the addition of dextrinized gruel certainly causes the milk to coagulate in fine, feathery, flocculent curds, when acted upon by rennin. In the stomach of some infants the effect is decidedly different. One case of miliary tuberculosis, which came to autopsy, showed a large, dense, tough curd in the stomach after having been fed four hours before death with a mixture which contained only 0.25 per cent. of protein. This may have been due to insufficient gastric motor power or to large doses of subgallate of bismuth which was administered to control intestinal hemorrhage. Koplik has made use of dextrinized gruels in about 50 cases of subacute and chronic enteric catarrh associated with marasmus. He believes this method of feeding to be of service in older children who refuse milk. He quotes Keller's experience as finding the amount of ammonia in the urine diminishing in marantic infants who suffer from an acid intoxication of the gut.

**Barley-water.**—Scald one tablespoonful of white pearl barley and throw away the water. One quart of water is then poured over the barley. It is allowed to boil down to one pint and is strained. Barley-water is useful for a short time in the treatment of the summer diarrheas as a substitute for milk. It contains a small amount of nourishment and is constipating. It is a useful vehicle for the administration of stimulants. It is also added to milk as a substitute for water to attenuate the curds in the presence of protein indigestion.

**Barley-gruel or Barley-jelly.**—Two to three ounces of barley-flour, either Robinson's or that prepared by the Cereo Company of Tappan, N. Y., are rubbed into a smooth paste with water and then sufficient water added to make one pint. Boil with constant stirring for twenty minutes, add sufficient hot water to make up for the amount evaporated, salt to taste. When cool the substance sets into a thick jelly. In making the gruel a little less barley-flour is used.

**Oatmeal-water.**—This is of service in the attenuation of the curd of cows' milk when used as a diluent in place of plain water, especially in the presence of constipation. Add one tablespoonful of oatmeal to one pint of boiling water. Simmer for thirty to sixty minutes. The bulk is again brought up to a pint by the addition of boiling water. Strain. Salt to taste.

**Oatmeal-gruel or Jelly.**—This may be made either from the plain oatmeal or from Cereo oat-flour. In the latter instance the preparation is similar to barley-gruel or barley-jelly. In the former three to four ounces of oatmeal are added to one pint of water. Boil for three hours, preferably in a double boiler. Water is added in the mean time to make up for evaporation. Strain. Salt to taste. When cool it jellies. It may be fed in this way or added to milk in varying amounts to attenuate the curd.

**Wheat-flour Water.**—This may be used as a diluent of milk in the presence of diarrhea. One to two teaspoonfuls of wheat-flour are added without lumping to one pint of water. Boil thirty minutes. Stir constantly. Add sufficient water to a pint. Strain. Salt to taste.

**Arrowroot-water.**— Rub one teaspoonful of arrowroot into a smooth paste with a little cold water. Add to one pint of hot water. Boil five minutes with constant stirring.

**Rice-water.**—This is used as a milk diluent in cases of diarrhea, or may be given plain to the infant. One tablespoonful of clean rice is covered with a quart of warm water and permitted to stand for one hour. Boil until the volume is reduced to one pint. Strain. Salt to taste.

**Dextrinized Gruels.**—Dextrinized gruels are made either from wheat-, barley-, oatmeal-, or rice- flour in the following manner: One to two tablespoonfuls of any of these flours is stirred into a thin, smooth paste with a little water. This is added to one pint and a half of water and boiled for fifteen or twenty minutes with constant stirring, using a long-handled spoon. The gruel is then removed from the fire and allowed to cool. When cool enough to taste, one teaspoonful of a preparation of diastase is added and mixed well with it. Upon the addition of diastase the gruel at once becomes thin and watery; 5 to 10 grains of taka-diastase may be dissolved in a teaspoonful of water. Use may be made of any preparation of malt, as Liebig's malt extract or of Cereo, which is a glycerite of diastase.

**Malt Soup.**—In 1898 Keller published reports of his experiments at the University Childrens' Clinic in Breslau. The preparation of choice is Loeflund's malt soup. It is a thick, syrupy substance of brownish color and pleasant odor. It contains potassium carbonate, the purpose of which is to overcome the acidity of the malt. It is employed as follows: From 1 to 2 ounces of malt soup are added to 1 pint of warm water (solution No. 1). From 1 to 3 ounces by measure of wheat-flour are smoothly mixed with 1 pint of milk and strained (solution No. 2). The two solutions are mixed and slowly brought to a boil with constant stirring. Cool and bottle. The amount of malt soup and flour may be varied as indicated. If diarrhea or vomit-

ing occur, less malt is employed; if abdominal distention, less flour. On the other hand, the proportions of milk and water may be adjusted to suit any desired percentages. The effect of mixing these solutions is to provide a dextrinized cereal—dextrin and maltose.

Milk prepared in this way has undoubtedly a large field of usefulness in marantic infants whose digestive organization is so delicate that it is next to impossible to secure a food that will agree or produce a gain in weight. Cases of essential marasmus often gain with tremendous strides when placed upon this food. Cases which have difficulty in digesting the curd, but show a tolerance for starch, are benefited, while those that vomit and have diarrhea do not thrive upon this food. The addition of malt soup should not be permanent, but is only to be employed for the purposes indicated—especially protein indigestion—and gradually discontinued when the bowels are normal or the weight ceases to increase. It is especially useful in cases which show acidosis as the ammonium output is decidedly lessened.

**Alkalies.**—Although, as stated, by the time that cows' milk reaches the consumer it is slightly acid, alkalies are not to be employed routinely, but for a distinct indication. This indication is to overcome hyperacidity, to assist in protein indigestion, and to overcome the effects of acidosis attendant upon too much fat in the food, as indicated by an ammoniacal urine. Of alkalies lime-water is the most commonly employed in the amount of from 5 per cent. (common) to as much as 20 to 30 per cent. of the milk mixture. Besides overcoming acidity, it causes the curd to become attenuated and improves the flavor of the milk.

**Sodium citrate** finds its greatest advocates in Wright and Poynton, of England, and Vaderslice and Cotton, of Chicago. It is added to milk in the strength of from 1 to 3 grains for every ounce of milk and cream in the mixture. It prevents, if in sufficient strength, coagulation of the milk in the stomach, thereby entirely eliminating gastric digestion. As can readily be appreciated, this is not desirable as a routine measure, weak digestion would be an indication, especially where the motor function is impaired or in cases of pyloric obstruction. The addition of sodium citrate, gr. 10 to gr. 30, before each feeding, either in the breast- or bottle- fed, is a valuable means of seeking to allay vomiting by permitting the milk to pass more readily into the duodenum on account of its unclotted condition. The exact manner of the action of sodium citrate is unknown. It is assumed that the citric acid liberated combines with the lime-salts of the milk, forming citrate of calcium. The calcium being thus bound, the free sodium unites with the free casein to form sodium paracasein, which, in contradistinction to the curd, calcium paracasein, is in solution.

**Sodium bicarbonate** is not commonly employed, but is indicated in hyperacidity, and is used in the strength of from 1 to 5 grains for every ounce of milk and cream in the mixture.

**Pasteurized Milk.**—This means the process by which the milk is subjected to a temperature of 155° F. for a period of about thirty minutes to an hour, after which it is rapidly cooled to 68° F. The best means of pasteurizing is by the Freeman instrument (Fig. 17). This consists of a metal bucket or pail which has a removable lid (*A*) and a groove encircling it about one-third from the bottom. In this bucket fits a metal rack (*B*), which is made to hold bottles

(*C*). Two sizes are made: one holding 10 bottles, the capacity of which is 6 oz., and one holding 7 bottles, the capacity of which is 8 oz. The rack has a wire crosspiece (*D*) by means of which it can be raised when the crosspiece is made to rest on a metal support (*E*) which projects into the bucket.

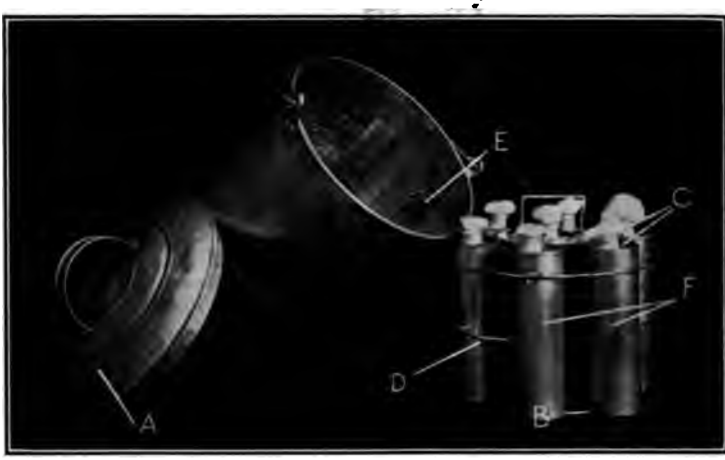



Fig. 17.—Freeman's pasteurizer. *A*, cover; *B*, metal rack; *C*, bottles; *D*, crosspiece; *E*, support; *F*, separate compartments. (Physician's Supply Co., Phila., Pa.)

The pasteurizer is filled to the groove with water and placed over a hot fire. When the water boils, each bottle, after being sterilized and having been filled with the desired quantity of milk mixture, is stoppered with sterile cotton and placed in its own compartment (*F*) in the metal bracket, and cold water is allowed to run into each compartment. Any compartments that do not contain milk formulas are occupied by bottles filled with water. The rack is then placed in the pail containing the boiling water. The lid of the pasteurizer is now adjusted and the apparatus is taken

from the fire. It is left undisturbed for from thirty minutes to one hour, when it is carried under a faucet of cold water, the lid removed, and the rack raised so the crosspiece (*D*) rests on the metal support (*E*) which projects into the bucket, and cold water is permitted to run into the pail, thus rapidly displacing the hot water. The bottles are now removed from the rack, stoppered with sterile cork stoppers, and placed on ice. Before feeding they are slightly warmed by being placed in warm water.

While it is true pasteurization does not make a dirty milk clean nor a fit food for infants, it is the best and safest procedure we at present possess. It is, perhaps, a good rule to pasteurize all milk, even when the method of its production is known to be the best, during four months of the year (June, July, August, and September). Some dealers sell pasteurized milk. This is a delusion and a snare, as it has been clearly shown that pasteurized milk is a better culture medium than raw milk. Hence the home product is best, as it is not kept sufficiently long to be exposed to contamination.

A rough method of pasteurization applicable to cases wherein expense is a desideratum, that is efficient, is to place the milk or formula into a sterilized Mason jar. The latter is then placed into a vessel containing cold water which reaches at least two-thirds up the sides of the jar. The water is brought to the boil, at which time it is removed from the fire, the lid placed upon the Mason jar, and the whole allowed gradually to cool off. The formula is now bottled. In summer this method is better than none at all, and is decidedly superior to sterilization, since the temperature of the milk, while rising higher than when using the Freeman apparatus, is considerably less than the boiling

point,—a fact of much importance if the process is to be continued over a long period of time.

**Sterilization.**—By sterilization is meant the destruction of germs by boiling. It may or may not include the destruction of the bacterial toxins. This depends upon the character of the toxin and its power to resist a temperature of 212° F. Boiling is usually continued for fifteen to twenty minutes. It is a fact that this milk can be kept for many months. It is further a fact, well established beyond dispute, that such milk fed to infants, over a long period of time, will produce scurvy and perhaps rickets. This is due to the chemical changes which occur in the milk. The boiling temperature coagulates the lactalbumin which rises to the surface, entangling the fat. It forms the so-called "skin" of boiled milk. Sterilized milk should not be fed to infants ordinarily. However, in some cases it may be the choice between two evils as a temporary measure. Thus, in the summer months, it may be the safer plan to tell the slum mother to boil her milk before feeding it to her infant, than to assume the risk of a severe intestinal infection. It is further borne out by clinical experience that boiling the milk for a short period (five minutes) greatly assists in rendering the curd digestible.

**Pancreatized Milk or Pancreatized Formula.**—This is sometimes poorly named peptonized milk. Predigested milk, which is synonymous, is a better term than the latter. Dissolve the contents of one of Fairchild's peptonizing tubes in 1 ounce of water. Add this to a pint of the completed formula. Mix. Place the vessel containing this in water of 115° F. for as many minutes as directed to do so. At the end of the required time, either divide into the number of needed bottles and place at once on ice, or bring the

mixture to a sudden boil. Either method will stop the pancreatization. If the formula or milk becomes bitter, the process has been carried too far.

*Uses.*—Pancreatized milk is useful in cases of indigestion where the baby cannot digest the curd or fat of the milk. It does well in some cases of essential marasmus.

Fig. 18.—Apparatus used in mixing formula. Pitcher, 16-oz. glass graduate, sugar measure, large spoon, nursing bottle, glass or agate funnel, corks. (Physician's Supply Co., Phila, Pa.)

The combination of 1 teaspoonful of pulverized flour ball to each bottle of pancreatized formula often forms a useful addition in curd dyspepsia.

**How to Prepare Formula.**—The preparation of the formula in the home must be done with care, especially with regard to cleanliness. This bears reference not only to the proper icing of the milk, but to everything else, including the hands of the nurse or mother, all utensils, water or

diluents, bottles and nipples that may come in intimate contact with the milk. The number of ounces of milk or skimmed milk required are placed in a large sterile pitcher made of glass or agate (Fig. 18). Into this is measured, by means of a 16-ounce glass graduate, the required amount of diluent. To this is added the sugar, salt, or any other solid ingredient required. A druggist will furnish a small receptacle or box marked to measure an ounce of

Fig. 19.—Nursing bottle.

Fig. 20.—A good type of nipple.

sugar by weight. The whole is thoroughly mixed with a large sterile spoon. It is now placed in bottles by means of a glass, agate, or tin funnel, previously sterilized. The bottles are preferably stoppered with sterile corks. If no further manipulation is required, the bottles are well iced after cooling, and placed preferably in a special nursery refrigerator (Fig. 23). Under no circumstances are they permitted to come in contact with food. If it be necessary to pasteurize, while in the pasteurizer the bottles must be closed with cotton which is later replaced by corks.

**Hygiene of the Bottle and Nipple.**—The successful feeding of artificially reared infants, aside from the chemical

composition of the milk mixture, necessitates the strictest attention to details. Of these the selection and care of the nursing bottle and nipple are matters of importance. Generally speaking, that bottle and nipple are the best which are simplest in construction and are the most easily cleansed. Bottles with many curves and angles are harmful. The use of nursing bottles with long rubber tubes is an abomination and should be prohibited by law. They are germ carriers, cannot be cleansed, and favor decomposition of the milk. The best bottle is one holding about 6 or 8 ounces, and which consists essentially of a graduated straight tube,

Fig. 21.—Bottle-brush. (Physician's Supply Co., of Phila.)

tapering slightly as it reaches the top (Fig. 19). The bottle should be thoroughly cleansed with Castile soap and hot water, using a stiff brush (Fig. 21) on a long handle. It is then thoroughly rinsed with plain, boiling water and filled with sterile borax-water when not in use. Before using, it is again thoroughly scalded. The brush used to clean the bottle must also be sterile.

The best nipples are those which allow the milk to flow easily but not too rapidly. When the feeding bottle is inverted, the milk should drop from the nipple and not run from it (Fig. 22). Nipples which permit the milk to flow rapidly produce colic. Those which flow too slowly may vex and irritate the infant. One of the best nipples is known as the Mizpah. The Davidson Health nipple is also a good

one (Fig. 20). Any nipple which is simple in construction and easily cleansed may be recommended. The nipples made from red rubber contain lead, therefore only the black-

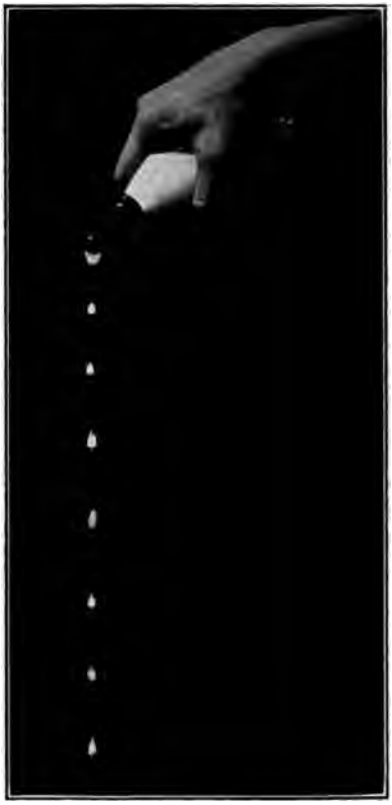


Fig. 22.—Showing correct rapidity of flow of formula through nipple.

rubber ones are to be employed. A nipple should not be used longer than a week, as the rubber becomes poor and is not easily sterilized. The same treatment should be accorded the nipples as the bottles, except that they should

not be boiled. They are turned inside out and well scrubbed with Castile soap and hot water. Afterward they are rinsed in hot, sterile water. When not in use they are kept in a solution of sterile borax-water or boric acid solution. Immediately before use they are immersed in sterile water. Blind nipples are purchaseable and are convenient


Fig. 23.—Nursery refrigerator. (Courtesy of Gimbel Bros., Phila.)

when it is impossible to secure nipples with sufficiently small holes. The latter are made by passing a fine, red-hot needle through the apex of the nipple. A great inconvenience, difficult to overcome, is the collapse of the nipple while the infant is sucking. In order to obviate this, a nipple and bottle called the Novac have been placed on the market and are of some value.

**Diet-kitchen; Refrigerator.**—If available, a small room especially set aside as a diet-kitchen, devoted entirely to

he preparation of the infant's food, is desirable. In hospitals this is essential. Among the poor, however, the physician, if he will but interest himself, can do much to mprove the hygienic surroundings, so that the preparation of the food may be accomplished with safety. Ice is essential to the preservation of the formula. A very convenient and hygienic arrangement is the nursery refrigerator, to which reference has already been made (Fig. 23). These refrigerators come in two sizes and may be purchased for from $1.50 to $3.00. The sides are packed with mineral wool. They are divided into two compartments, one in which the bottles may be kept surrounded with ice and another in which such things as the milk, barley-water, and beef-juice may be kept. Icing the milk or formula is a serious problem with the poor and ignorant, especially during hot weather. Very often a bottle half-finished will be permitted to lie around for several hours, to be again offered to the infant. This practice is exceedingly dangerous and must be prevented.

**How to Tell when Formula Agrees.**—The best evidence that the proper food has been selected for the infant is furnished by the condition of its digestion and its weekly weight record. The stools may not at once become normal. The change is usually gradual. Too frequent alterations in the composition of the food are not to be made. The individual digestive apparatus must be given an opportunity to become accustomed to the new food. This only applies to minor disturbances. Severe gastrointestinal derangements call for radical changes. A gain of from 5 to 7 ounces a week is normal. Less than this, in the beginning of the use of a new food, until the proper strength is reached is satisfactory. The infant's disposition while awake, and

its ability to secure a proper amount of sleep, are first-hand guides as to the success of the feeding, unless the baby be hampered and viciously trained.

**Feeding Routine; Amounts to be Fed; Feeding Interval; Diurnal Feeding; Nocturnal Feeding.**—No fixed rule can or should be given. The demands of the individual must be met. As the student requires some guide upon which to base his original advice which may be adjusted by future observation, the following, as representing the result of practical experience, is suggested. *Up to 6 months the number of ounces of each feeding may approximately be representel by the infant's age expressed in months. After this the progression is somewhat slower, so that at 1 year it receives about 10 ounces.*

The *feeding interval* should be every two hours until after 3 months, with two night feedings after midnight. The infant is to be awakened regularly for its meals during the day on the exact feeding hour, timing from the commencement of the last meal and not from the finish. Before feeding, the food is to be properly warmed by immersing the bottle in hot water. The formula will be of the proper temperature when it can be comfortably dropped upon the back of the hand. The bottle must be held for very young infants. The infant is not permitted to suck air. The neck of the bottle is always kept full. The infant may not sleep with the nipple in its mouth. The meal should be finished within from fifteen to twenty-five minutes. The food must not be given too rapidly. This may be guarded against by having a nipple which does not permit too rapid a flow, and by removing the nipple from the infant's mouth at the end of every third or fourth suck. The meal should be given with the infant lying down.

After feeding, its mouth is gently cleansed with boric acid solution and the infant must not be picked up. From the third to the end of the sixth month the feeding interval is lengthened to two and one-half hours; from the seventh to the end of the ninth month, every three hours; from this time to 12 months, every three and one-half hours.

After the fourth month, and sooner if feasible, no night feedings are to be given unless under exceptional circumstances. (See Vomiting, Chapter VII.) The adoption of some such routine has an excellent effect upon the patient's nervous development and its digestion. Good feeding habits are as easy to inculcate as vicious ones, and make for the comfort of the infant and the general good morale of the entire household. The infant should, if possible, be in a room by itself and left immediately as soon as its meal is finished and its general wants attended. Soon it will be found that the baby will respond to this scheme of regularity. It may take a week or more to accustom some infants to it, but the trial is worth the effort on account of the future comfort which ensues.

FEEDING TABLE.

| Age. | Amounts to be fed. | Feeding interval. | Daily quantity. | Night feedings. |
|---|---|---|---|---|
| Up to 3 weeks | 1 to 2 oz. | 2 hours | 11 to 22 oz. | 2 |
| Up to 2d month | 2½ to 3 oz. | 2 hours | 25 to 33 oz. | 2 |
| Up to end of 3d m. | 3 to 3½ oz. | 2 hours | 25 to 35 oz. | 1 |
| During 4th month | 4 to 5 oz. | 2½ hours | 32 to 40 oz. | 1 |
| During 5th month | 5 to 6 oz. | 2½ hours | 35 to 42 oz. | 0 |
| Up to end of 6th m. | 6 to 7 oz. | 2½ hours | 42 to 45 oz. | 0 |
| During 7th month | 7 to 8 oz. | 3 hours | 42 to 48 oz. | 0 |
| During 8th month | 7 to 8 oz. | 3 hours | 42 to 48 oz. | 0 |
| Up to end of 9th m. | 8 to 9 oz. | 3 hours | 45 to 50 oz. | 0 |
| During 10th month | 9 oz. | 3½ hours | 45 to 50 oz. | 0 |
| During 11th month | 9 oz. | 3½ hours | 50 to 55 oz. | 0 |
| Up to end of 12th m. | 10 oz. | 3½ hours | 50 to 55 oz. | 0 |

*Individual peculiarities* or *digestive disturbances* may necessitate a radical change in the feeding routine as to *feeding interval* and *quantity to be fed.* No absolute routine may be prescribed for all babies. Here as elsewhere individualization must be the basic keynote of practice. Thus the advocates of a regular four-hour interval may be as dogmatic as they desire to be regarded as progressive. Reference to the indications for shorter or longer intervals and for larger or smaller amounts to be fed will be found in their proper place within the body of the text.

**Bottle Feeding Among the Poor. Milk Stations.**—Among the poor, the artificial feeding of infants who are deprived of breast milk, is a problem that touches the question of infant mortality and concerns the State as well as the individual. Economic conditions underlie the entire situation. The conservation of the human milk-supply is vital, and it does not seem to be Utopian to express the hope that the nursing mother of the poor may some day become the ward of the State during the lactating period, or be paid outright for her services in nursing an infant so that she may be relieved of all other material responsibility during this time.

Where the infant is artificially reared, accurate adjustment to the individual's digestive peculiarities is just as possible, with some exceptions, if the physician takes the trouble to teach the mother, as among the better classes. The greatest difficulty is, however, to secure pure milk at a reasonable price and to keep the formula properly iced until used. Good milk cannot be secured if purchased from cans in the open market. For this reason milk stations have been established to provide it at cost or, in worthy cases, free. These milk stations, in conjunction with the visiting nurses,

have accomplished much in the reduction of infant mortality. It appears, however, to be a useless expenditure of funds where much more good could be done by sustaining the mother during the nursing period, as previously stated. Pasteurization if feasible and, if not, sterilization should be practised during the summer months. The latter is easier and more certain, and should always be advised without thought as to the future development of scurvy. This may be combated by the simultaneous administration of fruit-juices.

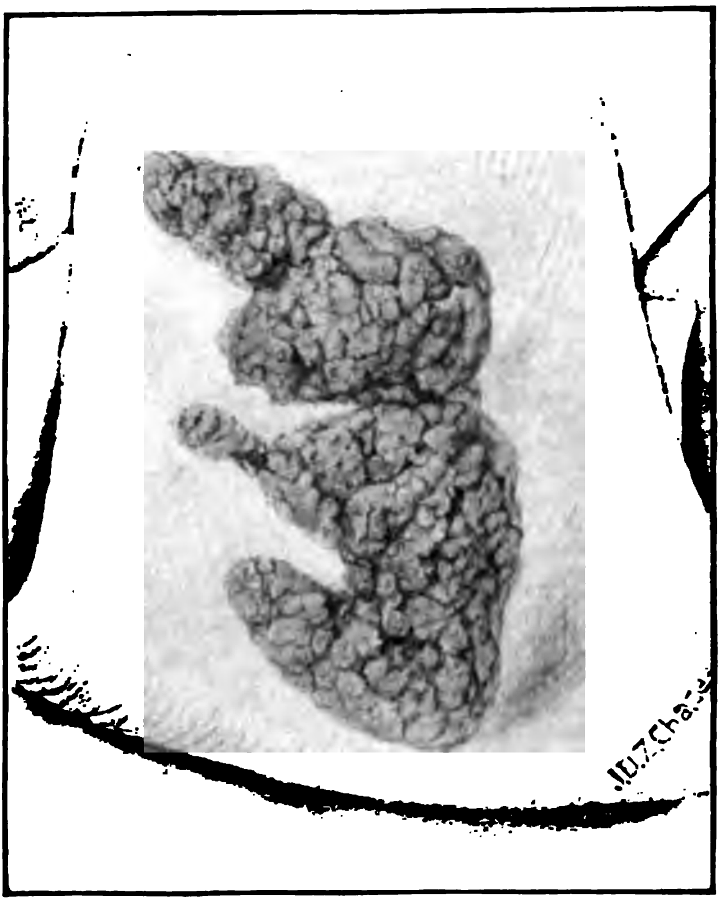
Condensed milk, being sterile, is a valuable makeshift when added to boiled water, and may be successfully used in many instances throughout the summer months.

**Feeding while Travelling.**—If the journey be short, occupying twenty-four hours or less, a day's supply of a formula may be prepared and placed in a sterilized Thermos bottle, or be bottled and put into a small receptacle, as a bucket, and properly iced. Where a journey of some distance is to be taken, as a sea-voyage, reliance may confidently be placed upon condensed milk or Ramogen.

## THE DIGESTIVE DISTURBANCES OF THE BOTTLE-FED AND HOW TO TREAT THEM.

Pediatrists are agreed as to the frequency of the digestive disturbances of the artificially reared, as well as to the serious and often fatal effects these may have upon the nutrition of the infant. Difference of opinion, however, exists as to the etiologic basis of these digestive upsets. The controversy as to which of the food elements, fats, protein, or sugar, of cows' milk, is responsible still continues, although the German contention, that most of the trouble depends upon a relative excess (for the individual) of fats

PLATE VIII



Hard, dry, whitish, constipated, crumbly stool, consisting of undigested protein, occurring in a bottle-fed baby. These movements are passed with much straining. (See text for treatment of protein intolerance.)

and sugar, and rarely upon a relative excess of protein, seems to possess at the present time the predominant influence upon the medical mind. An active feeding experience of fifteen years does not permit entire accord with this view. It is patent that the feeding of an excessive relative amount of any or all of the food elements may cause trouble, but the attempt to harness the responsibility upon one or more to the exclusion of the rest appears dogmatic and futile. The researches of von Pirquet clearly demonstrate that the infant thrives best when fed the food optimum (an amount just within the limit of the greatest quantity of food that the organism can assimilate, *i.e.*, the limit of food tolerance), and that loss of weight results from exceeding the food maximum as quickly as when the infant receives less than the minimum. In the *second instance* the loss of weight occurs because the food tolerance becomes lowered from the burden placed upon the digestive apparatus. Consequently assimilation becomes poor and the infant is practically in the same position as if he were receiving less than the minimum. He starves from overfeeding because non-digestion means non-assimilation. In the *last instance* weight falls because not enough nourishment is provided. The digestive organs, however, having been given a chance to rest, the limit of food tolerance is increased as evidenced by our ability to gradually increase the strength and amount of the food. Reference will again be made to this fact. Thus, while these statements, based upon von Pirquet's work, indicate that the digestive disturbances depend upon the fact that the food maximum has been exceeded, they do not mean that any one particular ingredient is responsible in all instances. A clinical fact of importance is that it is often possible to feed large relative amounts of one

food element while, if all are relatively large, trouble will ensue. Thus, a high fat may be tolerated when fed alone, but when exhibited with a high protein or a high sugar, or both, may be responsible for fat indigestion.

To exclude proteins as an etiologic factor of indigestion is a fallacy. Cases of this type do occur and are marked by definite symptoms. They are as common today as they were ten years ago, when, to the exclusion especially of sugar, nearly all digestive disturbances were laid at the door of this element. All so-called present-day curds in the stools are not fat. Clinical experience, very frequently, in spite of the researches of modern investigators, recognizes them as calcium paracasein, and they may be readily demonstrated to be protein by the xanthoproteic test. It is as impossible today to feed relatively or absolutely as high percentages of *chemically or mechanically unmodified* cow-curds as it was years ago, and to teach otherwise is dangerous and cannot but lead to disaster.

## PROTEIN INDIGESTION OR INTOLERANCE.

When an excess—and by excess is meant an excess for the individual, which in reality may be a small amount—of protein is fed to an infant, tolerance may persist for a brief period, to be followed by digestive disturbances and interference with the nutrition. Protein excess is rarely marked by vomiting unless the amount be so large that its speedy coagulation is followed by ejection from the stomach in the form of a tough, leathery mass within a short time after feeding. The main features of disturbance are confined to the intestinal tract. The stools are usually loose and green (Plate V). They have an unpleasant, but rarely foul odor, and contain considerable mucus and white or

whitish-yellow masses of undigested calcium paracasein (curd). These masses may exist in an otherwise normal stool. This is not indigestion, but non-digestion of relatively too much curd. In this instance the curds act as a foreign body, and if their presence persists they may cause serious intestinal irritation. These symptoms resemble the dyspepsia of Finkelstein, described by him as due to excessive fat or sugar. As before stated, the masses may be distinguished as being protein by the xanthoproteic test. The babies have colic and are very irritable.

In other instances, where too much protein is being fed, constipation exists, and the movements are hard, whitish, dry, and readily crumble (Plate VIII). They are passed with considerable effort, as a single mass covered with mucus, which may be blood-stained. Stationary weight or a loss is recorded in both these types of protein intolerance. The urine is often scanty, highly acid, and deposits of uric acid and urates are noted on the diaper. The temperature range in these cases is between 99° F. and 100½° F. or may be normal.

**Treatment.**—An initial purgative of from 1 to 2 drams of castor oil should be given. An excellent substitute consists of equal parts of castor oil and the aromatic syrup of rhubarb. Of this substance double the dose just indicated is to be prescribed. Initial purgation is followed by barley-water or whey feeding for twenty-four to forty-eight hours, or by weak tea sweetened with saccharin. In protein intolerance initial purgation is valuable and without danger. (See "Diarrhea," Chapter IX, page 267.) Whey is practically a 5 per cent. solution of milk-sugar containing 1 per cent. of fat and 1 per cent. of soluble proteins. To the whey, properly heated to 150° F. in order to destroy

any remaining ferment, may now be gradually added small amounts of plain milk or cream (split proteins). These, as tolerance is established, may be cautiously increased.

In mild cases it may be unnecessary to entirely eliminate the coagulable protein by whey feeding,' or whey feeding may not be continued long, a gradual return being made to the formula, starting with a weak mixture and gradually increasing. In this case it is advisable, for a short period at least, to pancreatize the formula (page 94). The time of pancreatization is gradually reduced and finally it is entirely omitted. After this the addition of some efficient digestive ferment to each bottle, just before feeding, is an excellent aid until the digestive function has been completely re-established.

The early teaching of Jacobi[1] advocating the use of cereal decoctions still holds good as an excellent means of rendering the paracasein easily digestible, and has received more recent emphasis from the work of Chapin, who employs dextrinized gruels (page 86). The cereal decoctions provide a certain amount of starch, which, according to the investigations of Kerley,[2] can be digested and assimilated by infants as young as 19 days.

Ordinarily barley-water made from the grain is to be preferred, either full strength or diluted one-half with boiled water. If constipation be present, oatmeal-water makes an excellent substitute. In this connection the old-fashioned flour ball has rendered excellent service. It may be baked to a bread brown and, after being pulverized and sifted, added to each bottle just before feeding. At the same time a few grains of the very best extract of pancreatin

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[1] Jacobi, A., "Therapeutics of Infancy and Childhood," p. 29.
[2] Kerley, C. G., "The Treatment of Diseases of Children," p. 126.

may or may not be employed. If the pancreatin is not pure, the stools may become foul. Flour ball may also be used as follows: 2½ to 5 per cent. of the total quantity of milk mixture is made to represent the amount of flour ball used. To this may be added 5 to 10 grains of pure pancreatin, or the pancreatin may be omitted. A portion of the completed formula is rubbed while cold with the flour ball so that a smooth paste results. The remainder of the formula is brought just to the boiling point in a double boiler. It is poured over the moistened flour ball and, if pancreatin has been added, it is maintained at this temperature for fifteen minutes, when the mixture is again raised to the boiling point, allowed to cool, and is bottled and iced. If no pancreatin has been added, immediately after adding the hot formula it is allowed to cool and iced without the second heating. The use of flour ball in this manner is, in the vast majority of cases, immediately followed by normal stools and a progressive gain in weight. A preparation on the market known as Benger's Food consists practically of pulverized flour ball and extract of pancreatin. It may for convenience be employed instead of the home-made flour ball. It gives excellent results as a curd modifier. I unhesitatingly commit the heresy of recommending it. Both of these preparations are gradually reduced and finally omitted.

Sometimes the simple boiling of the formula will render the protein digestible, but must not be continued too long without the addition of fruit and animal juices to the dietary.

Sodium citrate, gr. j to gr. iij, added to the formula for every ounce of milk and cream in the mixture, may render the curd digestible by causing it to remain fluid until it

reaches the small intestine. Its effects are not immediate and are usually revealed clinically within a few days. It is continued for some weeks, after which the amount is gradually reduced.

As a further means to overcome the indigestibility of protein, the use of mechanically divided curd is of great service and permits of the feeding of unusually large amounts. For this purpose, buttermilk and eiweissmilch (pages 121 and 126), especially the former, serve admirably as temporary foods or "pick me ups."

As already mentioned, Loeflund's malt soup as advocated by Keller is of service in removing protein masses from the stools in some cases. To epitomize, therefore, the following may be stated as the means of dealing with protein intolerance:—

1. Eliminate curd by whey feeding.
2. Split protein—whey and cream or whey and milk mixtures.
3. Pancreatization.
4. Cereal decoctions—plain or dextrinized.
5. Flour ball alone or pancreatized.
6. Benger's Food.
7. Plain boiling.
8. Sodium citrate.
9. Buttermilk.
10. Eiweissmilch.
11. Loeflund's Malt Soup.

### FAT INDIGESTION OR INTOLERANCE.

This, by Finkelstein, has been designated "weight disturbance" when occurring in its milder form. When of a more severe type, he calls it "dyspepsia," the symptoms of

which have been practically described as protein indigestion. No two babies can digest the same amount of fat. Difficulty is therefore experienced in attempting to arrange any set rule for the proper amounts of this ingredient to be fed. When intolerance occurs, the infant commences to vomit. The vomitus is sour, smelling like rancid butter, and occurs from an hour to an hour and a half after feeding. The bowels are often loose and just as often constipated. In the former instance they are acid, green, or green and yellow, and greasy, containing mucus and lumps of undigested fat, that may be mistaken for protein curds (Plates IV, V, and VI). These "curds," or masses, are softer, soluble in ether, burn when dried, are blackened by osmic acid, and are stained characteristically by Sudan III. The addition of a solution of Sudan III causes the fat particles and oil globules to appear red under the microscope. When placed in water, oil droplets are found floating on the surface.

When constipation occurs, typical soap stools (Plate VII) are found. The constipated stools are quite often solid, greasy, foul-smelling, and whitish or grayish white, or they may have a pinkish tinge (Plate VI). They frequently contain large or small granular masses of hard calcium soap, sometimes covered with mucus which may be blood-tinged (Plate VII). These stools result from the formation of fatty acids in the stomach and intestines. These acids combine with the mineral substances of the body and intestinal mucus. Thus a process of demineralization obtains. The direct result of this is a profound effect upon the whole nutrition. The weight remains stationary or a slight loss is noted. The infant becomes anemic, weak, and the bones commence to show evidences of poor

ossification, and enlargement of the epiphyseal junctions (incipient rickets).

The urine, on account of the large excess of fatty acids entering the blood and being there neutralized, becomes highly alkaline and emits a decided ammoniacal odor. If this condition of acidosis continues, the digestive processes are all disturbed and intolerance for all food may ensue, to be followed by marasmus or decomposition (Finkelstein). As a rule the temperature remains normal or is only slightly elevated at times.

**Treatment.**—An initial purgative of castor oil may or may not be valuable, depending upon the severity of the symptoms. In mild cases it should be withheld ("Diarrhea," Chapter IX, page 267. The temporary course of barley-water or whey feeding may be of service. However, where the diagnosis is certain, all fat had better be at once eliminated following a period of starvation. This is accomplished by the use of dilutions of fat-free milk (completely skimmed milk). These may be made half and half, or, better, 1 part of milk and 3 of water. Gradually, as tolerance is established, the dilution is made less and finally small quantities of cream may be added, or plain whole milk may be fed, at first well diluted. From 2½ to 5 per cent. of extra carbohydrate (sugar) is added. The fat is gradually increased, keeping well within the border of tolerance.

Where great acidity exists, marked by sour eructations, alkaline urine and soap stools, lime-water in quantities ranging from 5 to 25 per cent. should be added to all formulas. This seeks to prevent alkalinization of the fatty acids by the tissues of the body, thereby preventing demineralization and acidosis. Fresh buttermilk forms an

excellent substitute in fat intolerance. If made at home by the simple addition of lactic acid tablets, all cream should have been at first removed. The deficiency of caloric value, as the result of this, is made up by the addition of cane-sugar and wheat-flour in gradually increasing quantity (Chapter III, page 123).

Pancreatization may overcome fat intolerance without necessitating a great reduction in the amount of fat fed. It must not be continued too long, or the very purpose for which it was used will be defeated.

## SUGAR INDIGESTION OR INTOLERANCE.

Sugar has come into prominence as a great, if not the greatest, factor in the digestive disturbances of infancy. For reasons previously stated, personal experience does not permit of entire accord with this view. It has rarely been a source of trouble. The reason for this may be that routinely, following the teachings of Jacobi, cane-sugar, instead of the commercially impure lactose, has been employed. Frequent, watery, acid stools that excoriate the buttocks, associated with a sour, watery vomitus which irritates the esophagus and causes the infant to cry, together with flatulency and colic, are indicative of sugar indigestion. The urine may contain sugar; the baby may develop a high temperature and pass into a state of collapse on account of the frequent evacuations. A rapid loss of weight occurs,—intoxication (Finkelstein).

There are some infants who receive an excess of sugar and who do not suffer from indigestion, but grow fat. They are, however, flabby, anemic, and often develop rickets and scurvy at the same time, being subject to colds and to eczematous rashes.

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**Treatment.**—If the condition be acute and the symptoms of intoxication severe, castor oil and starvation for twenty-four hours are indicated. In mild cases initial purgation is unnecessary and does harm. During this time cereal-waters or weak tea sweetened with saccharin, gr. j to the quart, are employed. If not acute, this preliminary treatment may be omitted. In this condition Finkelstein's eiweissmilch finds its greatest field of usefulness. It is, unfortunately, very difficult to prepare, except in institutions, and hence may be impracticable. A good substitute consists of equal parts of buttermilk and of a wheat-flour solution (Chapter III, page 123). Both this and the eiweissmilch may be sweetened with saccharin, gr. j to the quart. The infant may be kept upon the buttermilk mixture for some time, and will gain, especially if gradually increasing amounts of cane-sugar or Dextri-Maltose are added.

As far as the addition of extra carbohydrates to milk formulas is concerned, increasing experience with it seems to demonstrate the value of maltose. This is found on the market as Mead-Johnson's Dextri-Maltose or as Loeflund's Food Maltose. Both are mixtures of dextrin and maltose. The latter is the more expensive, as it is an imported product. Both are used in the same manner as cane-sugar or lactose. A similar preparation is Soxhlet's Nährzucker.

Normal breast and bottle stools are shown in Plates II and III.

## DEFICIENCY OF FOOD ELEMENTS.

This is marked by slow growth, stationary or losing weight, irritability, and usually by a subnormal temperature,

unless the point of starvation is reached, when fever may occur. Constipation is the rule and the stools are normal in appearance, but of small bulk. Deficiency of food elements may not mean deficient bulk. In fact, this most often is excessive, but then the milk mixture is weak. It must be remembered that, aside from the characteristic digestive disturbances, the same features of nutritional impairment may be brought about by unduly strong mixtures, the excess causing digestive disturbances which may prevent proper assimilation. The patient actually receives a deficiency of all the elements. Rickets and scurvy may follow a deficiency in fat, protein, and mineral substances.

## FOOD IN IMPROPER QUANTITIES.

The average quantities of food have been stated previously (page 102). A formula may be suitable to the digestion of an individual, and yet be fed to him too frequently and in too large amounts. This is just as often the cause of digestive disturbances as excessive amounts of any special ingredient. It is noted in breast-fed children who are nursed every time they cry. These babies are always irritable, vomit, have bad bowels, and often lose weight. This is true, especially of bottle babies.

On the other hand, insufficient amounts of a correct formula may be given. These babies are always irritable, do not rest well, and, immediately after receiving the bottle, are unsatisfied, cry, and do not fall asleep at once as most babies do. They usually have a stationary weight or lose a few ounces. Increase in the quantity of the food is immediately followed by a gain in weight.

**FEEDING OF DELICATE AND SICK INFANTS.**

That this is a difficult problem gives no information, and yet in the handling of delicate babies who are not actually ill, but only below par, general rules may be given to be applied to the individual case as the indications demand. The digestion of these infants must be carefully watched, and at the first sign of trouble it is wise to immediately lessen the strength and quantity of the formula, or, perhaps, withdraw it entirely for twenty-four hours. Not a bad practice is to have the mother make the formula as heretofore, but just before feeding to pour out of the bottle one-half or three-fourths or one-fourth and replace it by water. A gradual return is then made to the full strength. Quantities to be fed must be regulated according to the tolerance of the stomach and the appetite. While it is desirable to give the stomach absolute rest, many cases do better when fed small amounts frequently. Here the peculiarities of the individual case must be studied.

Infants sick, of diseases other than those depending upon feeding or disorders of the stomach and intestines, must have their food carefully watched, as they are exceptionally prone to digestive upsets. Such an event may be the cause of a fatal outcome. In no disease is this better illustrated than in pneumonia, wherein an extensive and persistent tympanites often closes the issue. In acute illness food should be withdrawn for twenty-four hours, and a return to the original strength not be made until after the crisis, or the main symptoms have subsided. If digestion is sluggish, the formula should be pancreatized and fed in small amounts. Overfeeding should never be permitted, and the infant is not to be disturbed too frequently, either

for food, medicine, or other attention. It is frequently advisable, when gastrointestinal symptoms arise, to withdraw milk altogether during the entire course of the illness, and keep the patient upon animal broths or juices, alone or in combination with cereal decoctions, thin gruels, or albumin-water. For a more detailed description of this topic see Chapter XIII.

## CHAPTER III.

### ARTIFICIAL FEEDING.

*(Continued.)*

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#### IDIOSYNCRASY TO COWS' MILK.

THIS is an actual condition. The smallest amount of cows' milk may, in susceptible individuals, cause symptoms of gastrointestinal derangement, sometimes accompanied by skin rashes. Though rare, the physician should be sufficiently familiar with the symptoms to recognize them. Kerley has reported a case. The history of the following case is of sufficient interest to warrant a somewhat detailed report: This was a healthy infant, nursed from the beginning by a wet-nurse. The fat in the nurse's milk ran as high as 8 per cent., causing frequent attacks of fat intolerance, which were always overcome by treating the nurse with purgatives and by restriction of her diet. It became necessary to dismiss the wet-nurse. A carefully adapted formula, a little weaker than her milk, was prepared. The infant refused it and cried persistently whenever the bottle was offered. It was impossible to make him close his lips about the nipple. On one occasion the nipple was held in his mouth for an hour and a half, the patient crying constantly. He finally took 2 or 3 ounces. Within five or six hours he had diarrhea, vomiting, an urticario-erythematous rash on his abdomen and legs, and a temperature of 101° F. The symptoms speedily subsided after the administration of castor oil and the withdrawal of the milk. The wet-nurse had to be recalled. After this any attempt

to feed cows' milk was resisted and, when forced, was always followed by a rash and gastrointestinal symptoms. Weaning had to be finally accomplished by the direct feeding of solid foods and broths without milk. He is now 3 years of age, and each time he partakes of cows' milk or of foods cooked with milk he is troubled with digestive disorders and an eczematous eruption.

These cases are probably anaphylactic in character, and represent an example of so-called allergia to cow-protein. Whenever an infant vigorously refuses cows' milk, this in itself should be definitely considered before pushing the food. In Kerley's case the first symptoms also followed the forcing of the milk upon the infant. Laboratory investigations may later disclose a method whereby this type of protein intolerance can be recognized by a skin test done after the manner of the von Pirquet reaction.

## SUBSTITUTES FOR MILK FORMULAS.

**Whey.**—Whey is made by coagulating milk with rennin or essence of pepsin. To 1 pint of sweet or skimmed milk is added either 2 teaspoonfuls of liquid rennet or Fairchild's essence of pepsin. The milk is then placed upon the fire and gently heated to blood heat. It is then removed from the source of heat and permitted to clot. The clot is now broken up with a fork or a spoon, and the whole is filtered through 5 or 6 layers of narrow-mesh cheesecloth, without pressure. Whey, when correctly made, is almost transparent and should be free from oil globules and flocculi of curd.

When it is desired to feed a child upon a food in which casein is entirely eliminated, whey feeding may be employed. It is easily digested and forms an admirable

vehicle in which to administer stimulants. It is an excellent substitute for milk in the management of some of the gastrointestinal disorders of infancy. It may be given plain or diluted with milk, barley-water, or cream (see below).

**Whey-and-Cream Mixtures (Split Proteins).**—In the feeding of artificially reared children, the use of a whey-and-cream mixture may be of advantage. Before whey is added to cream or milk it should be subjected to a temperature of 150° F. in order to destroy the action of the rennin or pepsin. Otherwise the cream will curdle. The whey should not be subjected to a temperature higher than this, otherwise the lactalbumin will be coagulated. The mixtures of whey and cream may be of service in instances wherein milk or milk formulas are not tolerated at all. The good effects are shown by a gain in weight and normal stools. These mixtures are only to be regarded as substitutes, and a return to milk should be gradually made as tolerance is indicated. The cream is added in gradually increasing amounts, starting with f℥ss to f℥j to each bottle of 4 or 5 ounces of whey. Where it is desired to lessen the amount of calcium casein and to increase the whey-protein (lactalbumin and lactoglobulin), instead of whole milk in full strength, one may use sweet or skimmed milk diluted with varying quantities of whey. The proteins of whey equal about 1 per cent. Thus, if equal parts of whey and skimmed milk are added together, the resulting mixture would contain about 0.75 per cent. of whey-proteins and about 2 per cent. of calcium casein. These mixtures are also of use where plain diluted cows' milk is not tolerated. For practical purposes it is neither necessary nor useful to accurately calculate the percentages of split pro-

teins being fed. The guides are the infant's digestion and its weight.

**Wine Whey.**—Four ounces of sherry wine are added to 1 quart of milk and the mixture boiled. Strain through cheesecloth. It is useful as a stimulant fed in small amounts, plain or diluted with milk or cereal-water.

**Albumin-water.**—Add the white of 1 fresh egg to a pint of water. Shake well. Strain. Salt and sugar to taste if desired. Feed plain or dilute with cereal water, or employ as a vehicle for fresh beef-juice, orange-juice, or brandy. When all milk is withdrawn, albumin-water, plain or modified, as above, serves as an excellent substitute article of diet, in the treatment of diarrhea cases or other types of indigestion.

**Sour Milk or Acidified Milk; Lactic Acid Milk; Buttermilk.**—Milk to which lactic acid bacilli have been added, accidentally or intentionally, undergoes a process of fermentation whereby the different varieties of bacilli, of which the Bulgarian type is the most common, change the lactose to lactic acid. This process is partial or complete as the time of fermentation is short or long. Accidentally soured milk should rarely if ever be employed, as there is great danger of pathologic bacterial infection being present, as well as obscure chemical processes which may cause serious trouble. Depending upon the amount of fat desired in the sour milk, whole sweet milk or skimmed milk, sometimes previously sterilized, is employed. Previous sterilization is usually to prolong the souring for too great a length of time. To the milk is added 1 or 2 of the many varieties of lactic-acid-bacilli tablets to be found upon the market. These are previously dissolved in a little milk or water. Of these the Lactone Tablets of Parke Davis & Co., or those

prepared by Fairchild Brothers & Foster, or the Bulgarian Tablets of Hynson & Westcott, have given satisfaction, although all of them, at times, may be found to be inert. The milk is kept at room temperature overnight, after the tablet has been added. By morning, coagulation has oc-

Fig. 24.—Home buttermilk churner. (Gimbel Bros., Phila., Pa.)

curred. It is then beaten up, and is ready for use. If whole milk or cream has been used, after souring, it may be placed in a churner (Fig. 24) to remove the fat in the shape of butter, and the remainder, or the buttermilk, is decanted. Whole milk soured and simply beaten up, is erroneously designated as buttermilk. Soured skimmed milk more

closely approximates buttermilk which contains very little fat. The souring may be very conveniently brought about by simply adding to a quart of sweet milk a teaspoonful or two of sour milk. This is called a "starter," and takes the place of the tablet. Thus each day a little of the soured milk of the day previous may be used for this purpose.

The composition of these milks varies in fat content, depending upon whether they are made from whole sweet milk or skimmed milk. They contain approximately the same amount of protein as plain whole milk, and identical quantities of lactose which is considerably reduced by the fermentation. The composition of buttermilk varies, and depends whether it be made by simply souring skimmed milk or whole milk; or whether it is churned from sour cream or sour whole milk. It is poor in sugar and contains relatively more protein than fat. The protein exists in a finely divided state.

AVERAGE COMPOSITION.

| | |
|---|---|
| Protein | 3.0 per cent. |
| Lactose | 1.5 per cent. |
| Fat | 2.5 per cent. |
| Salts | 0.5 per cent. |

**Prepared Buttermilk.**—A preparation of buttermilk much used at the Philadelphia General Hospital (Blockley mixture) follows: Depending upon whether the living lactic acid organisms shall enter the infant's gastrointestinal tract or not, one of two methods may be employed:—

1. Three and three-fourths teaspoonfuls of wheat-flour are rubbed into a smooth paste with a little water, and sufficient water added to make a quart; 15¾ teaspoonfuls of cane-sugar are dissolved in this. The whole is boiled for twenty minutes with constant stirring, the water of

evaporation being replaced. Allow it to cool. Add 1 quart of soured whole or soured skimmed milk, or buttermilk.

2. After mixing as above, the mixture is again brought to the boiling point. The flame must be low and, as soon as heat is applied, vigorous stirring is commenced and continued until the boiling point is reached with but momentary interruptions; otherwise the curd will unite into a thick, tough, solid mass. At the end of the process sterile water is added to make the entire bulk equal 2 quarts. In this preparation the lactic acid bacilli are destroyed.

The amount of cane-sugar added may be varied as the condition of the infant's digestion indicates tolerance or otherwise. It may be often advantageously omitted entirely, when the mixture can be sweetened with saccharin gr. j to the quart. Used in this manner, especially if subjected to the second boiling, it may form a good substitute for eiweissmilch, which it closely resembles. The purpose of the addition of the flour is to take the place of the deficient fat and assist in the formation of a finely divided curd. The additional sugar also supplies heat and energy to supplant that of the sugar lost by fermentation, and also of the fat removed by churning.

*Indications.*—These different varieties of lactic acid milk are useful in disturbances of digestion where difficulty is experienced in taking care of the curd, or where a decidedly lessened amount of sugar is desirable. On account of the fine state of mechanical division in which it is found, the curd is rendered easily digestible. If fed raw, the additional effect of the lactic acid bacilli is secured. This may be of considerable assistance in tubercular enteritis. In one case the acid-fast bacilli were made to disappear. The more commonly useful mixture is the one

to which flour and sugar have been added. It finds its special sphere in intestinal conditions marked by protein and fat intolerance. Green stools, curds, diarrhea, and mucus, associated with loss of weight and, at times, temperature, often speedily disappear after the use of this food. If they persist, before the mixture is discontinued it should be tried without the addition of cane-sugar. In either instance the cessation of symptoms and the gain in weight, which may be a pound or more the first week, are at times only short of marvelous. Sugar may be cautiously added and slowly increased, after the stools become normal. Buttermilk milk mixture must not, however, be regarded as a permanent food.

A time comes when the gain in weight is quite small or does not occur at all; at the same time the infant seems to take a great dislike for the mixture which previously he had relished. A change must therefore be made to other food. This is done promptly, usually after omitting one feeding in order to allow the stomach to become completely empty. Either diluted skim milk (preferable at first) or diluted whole milk, with or without flour ball or Benger's Food, is substituted. Throughout the period of buttermilk feeding the infant receives from 1 to 2 drams of expressed beef-juice three times a day, as well as from 1 to 2 daily inunctions of codliver or olive oil. Two great advantages of the buttermilk mixture are its cheapness and the ease of its preparation. It therefore has a great field of usefulness among the poor and among the ignorant.

**Buttermilk Conserve.**—This comes in tin cans and resembles closely the mixture of buttermilk, wheat-flour, and sugar. It is thick and must be removed from the can as soon as the latter is opened. It is diluted with water. It

is a little more convenient therefore, especially while travelling, than the home-made mixture. Personal experience with it has been limited. The analysis provided by Biedert and Selter shows:—

| | |
|---|---|
| Proteins | 9.6 per cent. |
| Fat | 0.6 per cent. |
| Sugar | 30.0 per cent. |
| Salts | 2.0 per cent. |
| Lactic acid | 1.7 per cent. |
| Wheat-flour | 4.5 per cent. |

Where cane-sugar seems to cause disturbance, use may be made of a buttermilk conserve containing Dextri-Maltose, marketed by Louis Hoos, of Chicago.

**Eiweissmilch (Albumin Milk, Finkelstein's Milk, Protein Milk.)**—The following method of preparing eiweissmilch is practised by Finkelstein in his well-equipped diet kitchen in the Waisenhaus u. Kinderasyl in Berlin: 1 teaspoonful of any milk coagulant, as rennin or pepsin, is added to 1 litre of whole milk. This is thoroughly mixed and the vessel containing the material is placed in a water bath, the temperature of which is about 110° F. This raises the milk to about 100° F. Within a short period coagulation occurs and the entire mixture becomes solid. The mass is then incised by a complete crucial incision. This facilitates the escape of the whey. The coagulum is now placed in a suspension bag (made of either 4 or 5 layers of cheesecloth or of a porous material resembling a thin, unbleached muslin) for a period of four hours. This permits all the whey to escape, carrying with it the major portion of the salts and the sugar of milk. The tough curd is then pushed through a hair-mesh sieve in order to completely comminute it. This process is accomplished with a wooden spoon, or with a druggist's pestle, or with a wooden

instrument resembling a potato masher. It is repeated four or five times, adding about $\frac{1}{4}$ litre of water to facilitate the passage through the fine sieve. One-half litre of good buttermilk is added to the finely divided coagulum, and the entire mixture is again passed through the sieve. The bulk of the product should equal 1 litre, and, should it not, the deficiency is supplied by adding sufficient water. The mixture is now brought to the boiling point, meanwhile *stirring thoroughly and constantly from the moment that heat is applied. This maneuver is crucial* in its effect upon the perfection of the finished product. If it is not employed, the finely divided curd will become one solid mass. This accident seems to occur with great frequency in America, while in Finkelstein's kitchen it rarely ever happens. Whether this be due to the use of a special coagulant originally (Labessenz, made by Simon, Berlin c. Spandauerstrasse 17), or whether to the special and rather complicated apparatus which is employed to stir the mixture while it is being heated, is not quite clear, although I incline to the view that the latter is the case. In questioning the Sister in charge of the kitchen, on this point I could receive no definite information, chiefly, I believe, because she never experienced the difficulty. This special apparatus has a device which resembles an egg-beater, and for this reason I have employed one of the latter with which to do the stirring while the mixture is being heated. The stirring must be continued during the process of cooling, which is accomplished more rapidly by permitting cold water to run over the containing vessel. Many American authors, in giving their directions as to the manufacture of eiweissmilch, omit the final boiling. This is incorrect and does not represent Finkelstein's views. In my own experience I have

been able, almost without exception, to prevent this coagulation *en masse* by adding a dram of raw wheat-flour to the mixture before applying heat. While this practice too is irregular, it does not seriously interfere with the correct composition of the eiweissmilch, and certainly does not hamper the clinical results.

*Composition.*—Eiweissmilch is fat-poor, sugar-poor, and protein-rich. An average analysis follows:—

| | |
|---|---|
| Fat | 2.5 per cent. |
| Protein | 3.0 per cent. |
| Milk-sugar | 1.5 per cent. |
| Ash | 0.5 per cent. |

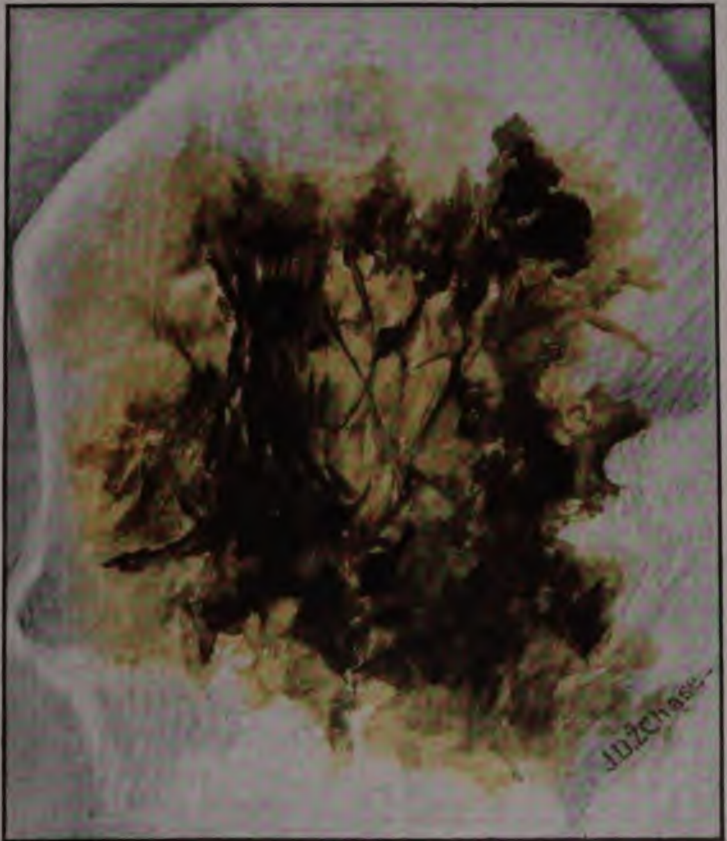
The calcium paracasein, or curd, is in a finely divided state. The milk is sterile. Eiweissmilch contains less sugar than buttermilk.

The difficulty experienced in preparing eiweissmilch in the home has caused its manufacture to be undertaken on a large scale in Germany. In America and also in Germany it may be found upon the market in powdered form; 90 grams of this preparation are added to 1000 cubic centimeters of previously boiled and cooled water, and thoroughly mixed.

*Larosan* is also a substitute product. It is eiweiss calcium, or a combination of the protein of milk and lime. About 2 per cent. is added to ½ litre of water. To this is added ½ litre of whole milk and the entire mixture is boiled. It is employed to correct dyspeptic stools before resorting immediately to eiweissmilch. Additional carbohydrate in the form of cane-sugar or of Dextri-Maltose may be added if desired. (See Diarrhea, Chapter IX.)

*Uses.*—Although usually employed full strength, eiweissmilch may be diluted. On account of its deficiency of

PLATE IX



Stool of a case of diarrhea discolored by bismuth. Notice absence of fecal matter and the excess of mucus. Artificially fed baby; stool commonly seen in intoxication. (See text for treatment of sugar intolerance and diarrhea.)

sugar, it may be rejected by some infants. In order to overcome this 1 grain of saccharin may be added to a quart. To increase its caloric value the addition of sugar in the form of Loeflund's Maltose or Mead-Johnson's Dextri-Maltose is usually made. At first 2½ per cent. and then 5 per cent. is added, four or five days after starting the feeding, or when the bowels become normal.

*Eiweissmilch undoubtedly finds its greatest field of usefulness in the treatment of summer diarrhea and next in cases of infantile dyspepsia, wherein difficulty is experienced in the proper digestion of the protein or fat, or both.* It is by no means to be regarded as anything but a temporary food, although some children gain slightly on it.

Its effect on the diarrhea and character of the stools is almost immediate. From 8 to 10 or more movements a day the number is speedily reduced and their appearance becomes whitish or brownish yellow, and constipated (calcium soap stools, caseate of lime). This change is so constant that it cannot be regarded as accidental. Maltose is not added to the milk until the stools are normal. *From eiweissmilch the change is made to the required dilution of whole or of skimmed milk immediately, as with buttermilk, but one feeding being omitted to allow the stomach to empty itself.*

**Ramogen,** a conserve, marketed in cans, represents a condensed form of Biedert's cream-and-whey mixture, the basic idea of which is to seek a combination of protein and fat acceptable to the infantile digestive apparatus. The relative proportions of protein, fat, and sugar in Ramogen are based upon the principle of the amount of food necessary for growth. The fat is rendered easily digestible by a process of emulsification. The proteins are not predigested.

The conserve is obtained by condensation at a low temperature. It is sterile. Cane-sugar is added as a preservative. The reaction of Ramogen is slightly alkaline. Its composition represents:—

| | |
|---|---|
| Proteins | 7.0 per cent. |
| Fat | 16.5 per cent. |
| Sugar | 34.65 per cent. |
| Salts | 1.5 per cent. |

This substance is especially useful in some cases of delicate digestion associated with marked disturbance of the nutritional balance. Cases of decomposition (marasmus) which have passed the gamut of patented foods and do not seem able to digest cows' milk formulas, however manipulated, have shown a remarkable gain in weight and passed on to complete recovery when placed upon this food. It also does well in many cases of summer diarrhea after the acute symptoms have subsided, following the period of barley-water or weak-tea feeding before milk formulas are again resumed, and where sugar is well tolerated.

Ramogen is employed by diluting it either with water (to be preferred) or with milk. The following dilutions are suggested:—

| Age. | Mixture. | | Calories | Percentages of | | |
|---|---|---|---|---|---|---|
| | Ram. | Water. | in 100 c.c. | Proteins. | Fat. | Carbhd. |
| First 3 weeks | 1 | 13 | 25 | .52 | 1.23 | 2.7 |
| 3 to 6 weeks | 1 | 11-12 | 27-26 | .56-.53 | 1.36-1.3 | 3-2.8 |
| 6 to 9 weeks | 1 | 10 | 30 | .63 | 1.48 | 3.1 |
| 9 to 15 weeks | 1 | 9 | 33 | .7 | 1.65 | 3.46 |
| 15 to 18 weeks | 1 | 8 | 35 | .77 | 1.81 | 3.8 |
| 18 to 21 weeks | 1 | 7½ | 38 | .81 | 1.93 | 4.0 |
| 21 to 24 weeks | 1 | 7 | 41 | .87 | 2.06 | 4.3 |
| 24 to 27 weeks | 1 | 6½ | 43 | .93 | 2.19 | 4.7 |
| 27 to 33 weeks | 1 | 6 | 45 | .98 | 2.31 | 4.8 |
| 33 to 49 weeks | 1 | 5½ | 50 | 1.07 | 2.54 | 5.3 |
| 39 to 44 weeks | 1 | 5 | 54 | 1.15 | 2.72 | 5.7 |

| Age. | Mixture. Ram. | Water. | Milk. | Calories in 100 c.c. | Percentages of Proteins. | Fat. | Carbhd. |
|---|---|---|---|---|---|---|---|
| 4 to 6 weeks | 1 | 12½ | 2 | 30 | .92 | 1.39 | 2.5 |
| 6 to 9 weeks | 1 | 12 | 3 | 33 | 1.17 | 1.54 | 2.8 |
| 9 to 15 weeks | 1 | 11½ | 3½ | 35 | 1.29 | 1.64 | 2.88 |
| 15 to 18 weeks | 1 | 11 | 4 | 37 | 1.42 | 1.74 | 3.0 |
| 18 to 21 weeks | 1 | 10½ | 4½ | 39 | 1.54 | 1.83 | 3.12 |
| 21 to 24 weeks | 1 | 10 | 5 | 41 | 1.66 | 1.92 | 3.24 |
| 24 to 27 weeks | 1 | 9½ | 5½ | 43 | 1.78 | 2.01 | 3.36 |
| 27 to 30 weeks | 1 | 9 | 6 | 45 | 1.92 | 2.11 | 3.5 |
| 30 to 33 weeks | 1 | 8½ | 6½ | 47 | 2.0 | 2.19 | 3.6 |
| 33 to 36 weeks | 1 | 8 | 7 | 49 | 2.18 | 2.24 | 3.76 |
| 33 to 39 weeks | 1 | 7½ | 7½ | 51 | 2.3 | 2.4 | 3.9 |

**Somatose Milk.**—This contains:—

| | |
|---|---|
| Proteins | 8.8 per cent. |
| Fat | 16.5 per cent. |
| Carbohydrates | 34.6 per cent. |
| Salts | 1.5 per cent. |

It is practically Ramogen containing lactosomatose, which is an albumose of casein and contains 5 per cent. tannin in firm chemical combination. Its purpose is supposed to take the place of the soluble lactalbumin in mother's milk, which plays an important factor in the easy digestibility of the curd. It is very readily assimilable.

*Indications.*—It is useful in all cases of weak digestion, in acute, subacute, and chronic inflammation of the intestinal tract, and in wasting diseases, as essential marasmus, scurvy, and rickets. It is employed in the same dilutions as Ramogen.

**Condensed Milk.**—Milk evaporated *in vacuo,* after sterilization, constitutes condensed milk. It may be sweetened or unsweetened, fresh or sold in cans. The last is the product commonly used. It contains a large amount of carbohydrate, mainly in the shape of cane-sugar, which is added as a preservative. When the can is opened the con-

tents should be poured into a china or glass pitcher. It is kept covered on ice, and should not be used after the second day. Its composition, according to the manufacturer, is as follows:—

| | |
|---|---|
| Fat | 9.61 per cent. |
| Protein | 8.01 per cent. |
| Carbohydrate (42.91 per cent. cane-sugar, 12.03 per cent. lactose) | 54.94 per cent. |
| Salts | 1.78 per cent. |
| Water | 25.66 per cent. |
| | 100.0 per cent. |

Condensed milk is *rich* in *sugar* and *poor* in *fat, protein, and mineral salts.* It has been a very much unjustly condemned food and, at the same time, a very much overused one. Infants fed *exclusively* on condensed milk grow fat, but have poor resisting powers, readily succumb to the acute infectious diseases and pulmonary trouble, and frequently develop rickets and, less often, scurvy. They are often anemic. Nevertheless condensed milk, properly diluted to the digestive capacity (about 1 part in 12 or 16 of water at the outset, increasing the strength up to about 1 in 6), is a valuable adjunct to our feeding armamentarium. It is best given diluted with a cereal-water. Where protein or fat intolerance exists, this food is often valuable. Especially has it been found useful in some cases of summer diarrhea as a go-between, as it were, between the starvation period and the time when a return is made to fresh milk formulas. *Condensed milk should only be employed in those cases of summer diarrhea where it can be proven that the condition is not dependent upon sugar intolerance.* After the acute symptoms have subsided a weak dilution of condensed milk is made with barley-water. This is gradually strengthened, and one bottle of the condensed-milk

feeding is daily or bidaily replaced by a weak fresh-milk formula, until all are replaced. The fresh-milk mixtures are then slowly strengthened. Condensed milk is cheap. It therefore must often be considered when feeding the poor, especially in rural or semirural districts, and also in summer, as it is practically sterile and requires only the addition of a sterile diluent. When travelling for a long distance, it, alone, may be depended upon. When continued over any length of time, it must always be supplemented by the feeding of fresh fruit- or vegetable- and beef- juice.

**Soya Bean.**—This has been much advocated by Ruhräh. The bean is made into a flour by the Cereo Company of Tappan, N. Y., and contains 44 per cent. protein, 20 per cent. fat, 10 per cent. cane-sugar, and a trace of starch. In infancy it has been recommended as a gruel: 4 to 8 level tablespoonfuls and a pinch of salt are added to 1 quart of water. Boil fifteen minutes. Strain. Add water to a quart. Cool. It may be used in this manner or added to milk. In order to prevent the gruel from settling, 1 to 2 teaspoonfuls of barley-water may be added. This adds 0.6 per cent. to 1.2 per cent. of starch.

## CURD MODIFIERS.

The following substances, useful as additions to or substitutes for cows' milk, merit special mention as mechanical modifiers of the curd of cows' milk:—

**Flour Ball (Plain).**— One pound of clean wheat-flour is tied in the shape of a ball in a bag made of unbleached muslin or balbriggan. The foot of a new, white stocking, size 10, will answer. It is placed in water and boiled continuously for eight hours. At the end of this time it is removed from the bag and placed on a plate in an oven and

slowly but completely dried out. It will appear with an outer skin, as shown in Fig. 25. It is now cracked, opened, and the inside is grated or pulverized and sifted. The pulverized flour ball is added to each bottle just before feeding, in the amount of from ½ to 1 teaspoonful, or it may be used as detailed in Chapter II, page 108.

**Flour Ball (Dextrinized or Browned).**—This is made as just described, except that after breaking open the ball is baked to a "bread brown" and this portion is grated and

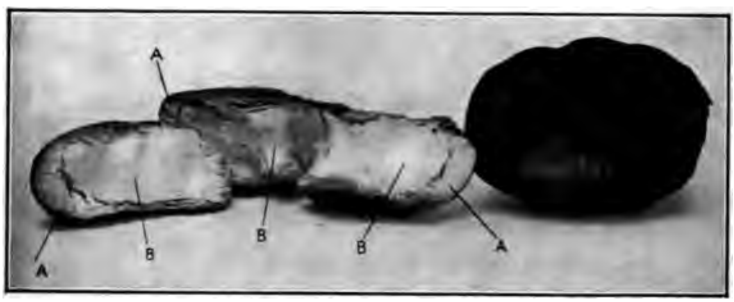



Fig. 25.—Flour ball. One is cracked open into three pieces. The inside (*B*) is pulverized and sifted. The hard shell (*A*) is discarded.

sifted. This baking process is repeated as often as necessary. Flour ball will keep indefinitely, provided it is kept perfectly dry and in an air-tight container. This is to prevent the growth of mold.

*Uses.*—This, an old-fashioned, time-honored "grandmother's remedy," has, unfortunately, been almost forgotten and passed into disuse. It is an excellent agent to add to the formula where the infant cannot digest the curd of the milk. It is especially healing and soothing when this condition is associated with diarrhea. When constipation supervenes, the amount of flour ball should be gradually lessened and finally omitted. Browned or dextrinized

flour ball should be used in those cases where the plain flour ball produces too much gas, as it may in infants who cannot digest starch very well. In addition, in these instances, when the simple browning is insufficient, 1 or 2 grains of Fairchild's extract of pancreatin may be added to each bottle.

**Benger's Food.**—Though a proprietary, as a curd modifier this food may justly find a permanent place in the dietetics of infancy. It consists simply of extract of pancreatin and of pulverized flour ball, and may be conveniently used as a substitute for it, as the long time required for the preparation of the latter is thus omitted. This food is used in the proportion of 5 per cent. of the total formula or less, usually less (2½ per cent.). The ingredients of the formula, with the exception of the Benger's Food, are mixed in the usual manner. A small quantity of the mixture, about an ounce or two, is rubbed into a smooth paste with the Benger's Food. The remainder of the formula is brought to the boiling point in a double boiler.[1] This is then poured over the paste. Mix well; allow to stand fifteen minutes without fire, but covered. Heat quickly a second time to the boiling point in a single boiler placed over a low flame. Stir the mixture constantly to prevent burning. Cool. Bottle. Ice.

The effect upon green stools is *almost immediate,* changing them to a smooth yellow, with a normal or slightly acid reaction. The amount of Benger's Food is gradually reduced and finally omitted. The only objection to the use of this preparation is that the milk must be boiled. In sum-

[1] It must be remembered that substances do not *actually boil* in a double boiler. They simply steam and bubbles are seen about the edges; or the temperature may be taken with a thermometer.

mer this is an advantage. If the necessity for its prolonged use exists, fruit- and meat- juices must be fed to the infant.

**Imperial Granum.**—From 1 to 2 tablespoonfuls of Imperial Granum are added to 1 pint of milk and boiled one-half hour. At the end of this time the addition of a sufficient quantity of water is made to bring the total volume up to a pint. As a cereal-water Imperial Granum is a useful curd modifier, and adds materially to the nutrition of the formula on account of the extra starch, which most infants are able to digest at a very early age (Kerley). This preparation must also be reinforced by the feeding of meat-, vegetable-, and fruit- juices.

## SUBSTITUTES FOR MILK-SUGAR.

For reasons previously stated the milk-sugar of commerce frequently forms a poor substance with which to provide extra carbohydrate. For this purpose other sugars have been employed.

**Cane-sugar (Saccharose)** in many instances is an excellent substitute. Experience with it has verified all that is claimed for it by Jacobi. One ounce equals about 120 calories.

**Mead's Dextri-Maltose and Loeflund's Food Maltose.**—Malt-sugar, or maltose, is more rapidly absorbed than either lactose or saccharose. The degree of assimilability of these three sugars is indicated as follows:—

| | |
|---|---|
| Maltose .......... | 7.7 grams + per kilogram (Ruess). |
| Lactose .......... | 3.1 to 3.6 grams per kilogram (Gross). |
| Saccharose ....... | About the same as lactose (Ruess). |

The power to assimilate maltose is therefore double that of the other two. It has been further shown that larger amounts of maltose can be taken by the infant than either

of lactose or saccharose, without sugar appearing in the urine. This is probably due to the fact that maltose, absorbed as such into the body, is acted upon by a special ferment found in the muscles, blood, and other tissues. Maltose causes a more rapid gain in weight. Its combination with dextrin increases this power. It does not readily ferment in the intestinal tract. For dietetic purposes, however, pure maltose is inaccessible on account of its expense. It therefore appears on the market in combination with dextrin in the shape of Mead-Johnson's Dextri-Maltose and as Loeflund's Food Maltose. These resemble each other closely; the latter being imported, is therefore more expensive. They are each added to the formula in any extra percentage desired, from 1 to 5 per cent.; 1 ounce to a 20-ounce mixture equals 5 per cent. extra carbohydrate. When maltose is employed the stool is often characteristically brown or brownish yellow. One ounce of either of these preparations approximates 120 calories.

*Composition of Dextri-Maltose.*—This practically consists of starch converted by malt diastase, the percentage of maltose and dextrin being respectively regulated by the temperature at which the process is stopped and the length of time of exposure to this temperature. It contains neither cellulose, protein, nor fat:—

| | |
|---|---|
| Maltose | 51.0 per cent. |
| Dextrin | 42.7 per cent. |
| Salts | 2.0 per cent. |
| Moisture | 4.3 per cent. |

*Composition of Loeflund's Food Maltose.*—Loeflund's Food Maltose contains, approximately:—

| | |
|---|---|
| Dextrin | 60.0 per cent. |
| Maltose | 40.0 per cent. |
| Salts | 0.3 per cent. |

**Soxhlet's Nährzucker.**—This preparation is marketed by the Arcady Farms of Lake Forrest, Ill. It is added as extra carbohydrate in the amounts of 1 to 5 per cent. of the milk formula. It is called nutrient sugar, and was elaborated by Prof. Dr. Soxhlet. It is dissolved in boiling water. The milk and other ingredients of the formula are added and the whole sterilized. Its composition is similar to Dextri-Maltose and Food Maltose.

## FEEDING AFTER THE FIRST YEAR.

At 12 months an infant should be receiving whole, undiluted, cows' milk. At this time additions should be made to the dietary in the shape of cereals, and other foods to be detailed. This statement bears modification in so far as some infants are able to digest whole milk at an earlier age, and, at the same time, to receive foods that require chewing. Others, again, may not be able to take care of strong food at this time. It is clearly a problem of the individual. Many children beyond a year of age are seen whose nutrition has suffered for the want of strong food, and who are weak and undernourished. In these cases a change in diet to solids is productive of marvelous results. On the other hand, it must not be forgotten that malnutrition results as well from overfeeding as feeding an infant things which it cannot digest. How are we to judge, and what are the guides to indicate that the gastrointestinal tract is ready for the digestion of food that requires comminution? Aside from the condition of the general health and of the digestion, *the one single thing that would indicate digestive strength is the presence of several teeth.* This is a safe indication to commence the feeding of solids

and semisolids irrespective of the age, provided the infant is not suffering from indigestion.

The use of the bottle should not be permitted beyond 12 months in most instances, and promptly at this time the infant may be taught to take its milk from a cup. Some babies take and relish other food, especially thin cereals and rusk or zweiback, as early as 6 months, but as a general proposition the end of 12 months is the best time to commence extra feeding. A practical point of importance is the statement frequently volunteered by the mother, that her baby will not take this or that food. The acceptance of foods other than the bottle is a matter of education, and the baby must get used to the new substances. Thus, an infant may refuse an egg. It should not be forced, but one should be offered to it again in a few weeks or a month. The additions to the food should be gradual and should consist primarily of well-cooked cereals, as oatmeal, cream of wheat, and cornmeal. These should be cooked at least two hours, with or without milk, and served either with milk and sugar or with butter or meat-juice. Rice is a useful cereal at this time, but must be cooked at least three hours. Mashed baked potato (page 147), with milk and butter or beef-juice, is of value. Bread and butter may also be allowed. For desserts, junket or rice-, sago-, or other pudding, or mashed baked apple, or the inside of prunes, may be used. At this age infants should receive not more than five, and better but four, meals a day, so arranged as to give plenty of rest for the stomach, and that the heaviest meal should be given in the middle of the day and the lightest at night. The schedule appended has given uniform satisfaction:—

DIET No. 1.

Diet for ....................................Age ...................

Date ...................................

**Breakfast** (6.30 to 7 A.M.).—(1) Glass of milk and stale bread broken in it. (2) Cereal, as oatmeal, arrowroot, rice, grits, cooked at least two hours (rice, three hours), and covered with milk. If desired, can be sweetened to taste. (3) Soft-boiled egg and bread and glass of milk.

**Second Meal** (10 A.M.).—Milk.

**Third Meal** (2 P.M.).—(1) Beef-blood, beef-tea, or fat-free gravy containing stale bread broken in it, and a glass of milk. (2) Rice and grits cooked three hours or mashed baked patato with beef-tea or beef-blood or gravy. (3) Soft-boiled egg, buttered stale bread, and glass of milk. Rice-, sago-, or other pudding, or junket, can be given for dessert; mashed baked apple.

**Fourth Meal** (5 P.M. to 6 P.M.).—Glass of milk or milk and crackers.

**Fifth Meal** (9 to 10 P.M.).—Glass of milk.

This diet should not be used *beyond* the age of 18 months.

The fifth meal may preferably be omitted and the time of feeding indicated may be adjusted to fit the routine of the household. If an infant has been kept on the breast up to the age of 12 months or longer, the change to this diet may be made at once, except that, where it calls for milk, diluted milk may be given at first. If an egg be given for breakfast, it should not be given at the midday meal, one a day being ample.

At the age of 18 months, further additions may be made, especially at the midday meal. Soups made from mutton, fish, or chicken, either plain or containing a cereal or vegetable, are valuable. The most important addition is meat in the shape of finely cut, rare, broiled steak; lamb-chop, roast beef, boiled fish, or white meat of chicken. Desserts may include custard and bread-pudding. Only three prin-

cipal meals a day are given, with a very light lunch between, at 10 A.M. and at 4 P.M.:—

DIET No. 2.

Diet for .................................... Age ..................

Date ..................................

**Breakfast** (7 to 8 A.M.).—(1) A slice of bread and butter or soda or graham cracker, or shredded-wheat biscuit with a glass of milk. (2) Soft-boiled egg, glass of milk, bread and butter. (3) Oatmeal, arrowroot, wheat-grits, hominy, cream of wheat (farina), cooked at least two hours with milk; glass of milk.

**Lunch** (10 A.M.)—Glass of milk with stale bread, zweiback or cracker, buttered if preferred.

**Dinner** (2 P.M.).—(1) Rice boiled three hours, with meat-gravy or milk, or mashed baked potato moistened with butter or beef-juice; glass of milk. (2) Clear vegetable soup or soup made from mutton, lamb, fish, or chicken, clear or containing rice, celery, sago, farina, or stale bread or crackers broken in it; bread and butter, and rice-, sago-, or bread- pudding; custard, junket, apple-sauce, or stewed prunes (pulp), as dessert. (3) Soup, small piece of finely cut white meat of chicken, broiled lamb-chop, tender steak, roast beef, or boiled fish, bread and butter, and dessert.

**Afternoon Meal** (4 P.M.).—One to three lady fingers, or piece zweiback.

**Evening Meal** (6 P.M.).—Bread (plain or buttered) and milk.

This diet is not to be used *beyond* 2 years.

## FEEDING AFTER THE SECOND YEAR.

The diet now commences to assume more of the characteristics of that of the adult, in that a greater variety of food is allowed. The afternoon luncheon is often omitted. Occasionally a little pure ice-cream and a lady finger are allowed. Between 7 and 8 A.M. breakfast is served and consists of orange-juice, scraped raw apple, raw ripe or stewed peaches, apple-sauce, California grapes freed of skin and seed, baked apple or stewed prunes, cereal—as oatmeal,

hominy, wheaten grits, cream of wheat, or other porridge; a small portion of finely cut beefsteak (broiled) or lamb-chop, and bread and butter and a glass of water. If meat be omitted, and it should be if fed at noon, an egg and a glass of milk may be substituted in the morning. At 10 A.M. the child may receive its bath, to be followed by a small glass of milk and a cracker, or a small cup of broth. Its morning nap follows. Dinner is served at 1.30 or 2 P.M., and consists of soup, a meat, two vegetables, bread and butter, dessert, and a glass of moderately cold, pure water. The varieties for selection are noted below. At 6 P.M. a supper consisting of bread and butter and milk, or bread and butter and apple-sauce and water, is given:—

DIET No. 3.

Diet for ..................................... Age ..................

Date ....................................

**Breakfast** (7 to 8 A.M.).—(1) Orange-juice, scraped raw ripe apple, raw ripe or stewed peaches, apple-sauce, grapes freed of skin and seeds, baked apple or stewed prunes, oatmeal, hominy grits, wheaten grits, cream of wheat, or other cereal porridge, well cooked and served with plenty of milk and sugar to taste; small portion of finely cut broiled beefsteak or lamb-chop, with bread and butter. (2) Cereal and fruit as above, with soft-boiled or poached egg, with bread and butter and a glass of milk.

**Second Meal** (10.30 A.M.).—(1) Glass of milk, with bread and butter, or soda cracker. (2) Bread and milk or graham crackers and milk. Chicken- or mutton- broth, with bread or crackers.

**Dinner** (1.30 P.M.).—Clear soup made from beef, chicken, lamb or fish, or soups containing well-cooked rice, barley, farina, celery, or noodles, or oyster- or clam- broth; roasted or broiled or stewed chicken, turkey, squab, beef, lamb, fresh fish cut fine; mashed baked potato with butter or beef-blood on it; stewed celery; asparagus tips; spinach (German style); stewed noodles with milk dressing; stewed onions; skinned and mashed peas and lima beans; creamed squash; bread and butter. As dessert, rice-, sago-, tapioca-, farina-, or plain bread- pud-

ding; junket, egg-custard, or cornstarch, or any of the fruits mentioned above. (Selection for dinner should consist of a soup, one meat, not more than two vegetables, bread and butter, and dessert.)

**Supper** (6 P.M.).—Bread and butter and milk, or crackers and milk.

Diet not to be used for child *under* 2 years.

If absolute regularity is practised at this time and no departure is made from the foods contained in the list appended, there will be no digestive derangements. Overfeeding or yielding to the importunities of the child will only bring disaster to it and sorrow to the household. Tea, coffee, pastries, and an undue amount of sweets, a piece of chocolate being allowed each day, fresh bread, beer, alcohol in all forms, made dishes, smoked or pickled foods, cheese, bananas, an excessive amount of cakes and ice-cream should find no place in the child's dietary, even up to the age of 5 or 6 years. It is just as easy to train a child to eat and to relish the correct foods as it is to allow it to eat indigestibles. The gain to its digestion and nutrition is increased many fold.

### DIFFICULT FEEDING CASES AFTER THE FIRST YEAR.

In those children who cannot take whole milk, Diet No. 1 may be given with the breast or with diluted milk, or with no milk at all. These cases often follow an attack of summer diarrhea late during the first year, or during the first half of the second year. A return to milk means a renewal of symptoms, and main reliance must be placed upon mutton- or beef- broth, cereals—as rice and farina, and stale bread, and eggs. A diet of this kind will often cause the stools to become normal without the use of medication. The return to milk must be made with the utmost caution, using it boiled at first and well diluted.

Again, cases of delicate digestion occur, in which it is impossible to place one's finger exactly on the cause. All that can be said is that the children are delicate. Here individual experience and experience with the individual child, alone can be our guide. The dietary must be carefully scrutinized, and each article that seems to disagree must be eliminated. The stools must be carefully studied in order to learn what substances pass undigested. As a rule, highly seasoned or overfatty foods cause disturbance. In no instance should the evening meal be large, and great care to prevent overfeeding should at all times be taken, the preferable idea being to give several small meals. Where vomiting occurs as a frequent symptom, proteins are to be avoided, as they may be responsible for an increased acidosis, as shown by acetonuria, and the acid fruits and carbohydrates are to be especially pushed. Where night-terrors occur, with febrile attacks and indicanuria, reduce the proteins and sugars and increase the supply of water. During an attack of fever all food had better be withdrawn, or at best the diet reduced to simple liquids (Chapter XIII).

### FOOD RECIPES.

**Beef-tea No. 1.**—To 1 pound of lean chopped beef, free of fat, add 1 quart of water. Boil one hour, renewing the water from time to time. Strain. Cool. Remove fat. Salt to taste. Warm before feeding. Fresh daily.

**Beef-tea No. 2.**—To 1 pound of lean chopped beef add 1 quart of boiling water. Keep warm one-half hour. Strain. Place on ice. Remove fat. Salt to taste. Warm before feeding. Fresh daily. This is more rapidly made than No. 1.

Both may be used as substitute articles of diet, plain or

PLATE X

Same case as Plate IX. Diarrhea more advanced. Note blood and mucus; some green and discoloration by bismuth. Very little milk feces present.

in combination with white of egg, egg-water, cereal-water, or a small amount of the cereal itself may be added. For older children celery or onion flavoring may be used.

**Expressed Beef-juice.**—Cut into squares one-fourth to one-half pound of fresh lean beefsteak. Rump or round will do. Place in a clean pan without fat or butter, and heat until the pieces of meat are just "whitened" on all sides. Express the beef "juice" or blood with a clean lemon-squeezer. Salt to taste. Keep on ice. Remove fat. Give infant from f℥ss to f℥ij three times a day on an empty stomach. Exactly one-half hour before feeding is to be preferred. Before feeding it, heat by placing the desired amount in a spoon and holding the latter over some steam. If the juice changes color and becomes brown it has been heated too much and must be discarded for other. The purpose of heating is to warm it—not to cook it, otherwise the purpose for which it was given will be lost. Expressed beef-juice should be fed to all bottle babies after the second or third month, and should be continued until after the nursing period. Most infants enjoy it. It prevents, and assists in curing rickets and scurvy.

**Mutton-broth.**—To 1 pound of fresh, lean, chopped mutton add 1 quart of water. Boil one hour. Renew water as it evaporates. Strain. Cool. Remove fat. Salt to taste. Fresh daily. Warm before feeding. Useful in cases of diarrhea, alone or in combination with egg-albumin, cereal-water, or the whole cereal.

**Veal-broth.**—Made as above, substituting veal. Useful in constipation.

**Chicken-broth.**—To every pound of chicken add 1 quart of water. Proceed as under mutton-broth. A useful sick-room delicacy, alone or in combination as above.

**Squab-broth.**—To one freshly killed and thoroughly cleaned and washed squab, add sufficient water to cover, and a handful of washed celery tops. Boil from twenty minutes to one-half hour. Strain. Cool. Remove fat. Salt. An excellent stimulant to the appetite. Useful as a change. May be used plain or in combination with cereals, especially well-cooked rice.

**Vegetable-broth.**—Thoroughly wash 1 beet, 1 carrot, a handful of spinach, and some celery tops. Add 1 quart of water. Boil until vegetables are tender. Strain. Add sufficient boiled water to make a quart. Salt to taste. Useful as a laxative, antacid, antiscorbutic, antirachitic, or antiexudative.

**Creamed Broths.**—Any of the broths above detailed may be creamed or thickened. Rub 1 medium-sized tablespoonful of wheat-flour into a smooth paste with a cupful of the cold broth. Add remaining portion of the quart. Bring to boiling point with constant stirring. Cool. Salt to taste. Warm before using. This adds to the bulk and nourishment of the broth and assists in its constipating effect.

**Burnt-flour Soup.**—Brown 1 tablespoonful of wheat-flour in a clean pan, with or without butter. Add 1 quart of water and bring slowly to boiling point with constant stirring. Salt to taste. Very useful in diarrhea in older children. Fed cool or warm.

**Beef-jelly.**—To 1 pound of fresh, lean, chopped beef add 1 pint of water. Boil one hour. Renew water. Strain. Salt to taste. Allow to cool, when it jellies. A sickroom delicacy.

**Rice.**—Wash a cupful of best rice several times with warm water. Add sufficient water to cover it. Boil three hours. Renew water from time to time as needed. Strain.

Salt to taste. Rice should be mushy. Taken with milk, mutton-broth, butter, salt, meat-juice, or sugar and cinnamon. May be mixed with apple-sauce.

**Cornstarch.**—Rub 2 tablespoonfuls of cornstarch into a smooth paste with milk. Heat what remains of 1 quart of milk. Beat up 2 eggs well. Add the hot milk, the eggs, and 2 ounces of sugar and a little salt, to the cornstarch paste. Mix well. Bring to a boil, stirring constantly.

**Cornmeal-gruel.**—One-half cupful of selected yellow cornmeal is sprinkled into 1 pint of hot water or hot milk. Salt is added. Cook for one hour in a double boiler.

**Arrowroot.**—Rub 1 teaspoonful of best arrowroot into a smooth paste with little milk. Add ½ pint of boiling milk, meanwhile stirring. Cook five minutes without burning. Sweeten and salt to taste. It may also be flavored with vanilla or cinnamon, etc.

**Arrowroot-water.**—Add, without lumping, 1 teaspoonful of arrowroot to 1 pint of water. Boil one-half hour. Renew water to a pint. Salt to taste. Useful as a drink plain or flavored with vanilla or added to milk as a diluent to attenuate the curd.

**Cream of Wheat, or Farina.**—Made as cornmeal-gruel.

**Stewed Squab.**—See squab-broth, page 146.

**Baked Potato.**—Wash a large potato clean. Dry. Punch full of holes with a fork. Dampen the outside and cover with salt. Put in a hot oven in a pan in which salt has been placed. Bake quickly. Break open at once. Mash and serve with milk, butter, or beef-juice. Salt to taste.

**Spinach.**—Wash spinach ten times with cold water, removing all grit and worms. Cover with water to which a little salt has been added. Cook until tender. Place in a

collander to remove all water. Chop very fine on a clean board. Brown a little flour with butter, in a pan. Stir in the spinach until hot. A little milk or cream may be added if desired.

**Stewed Celery.**—Separate stalks of celery. Thoroughly wash. Cut stalks into small pieces. Cover with slightly salted water. Stew until tender. Pour off water. Add a little plain milk or milk to which a little flour has been added. Add a small piece of butter, dash of salt and pepper. Heat to boiling.

**Stewed Onions.**—Pare young onions of medium size, then prepare as celery.

**Coddled Eggs.**—Place a fresh egg in boiling water. Remove from fire. Allow egg to remain immersed two minutes. Open at once.

**Egg-water.**—The white of 1 fresh egg, beaten slightly, is added to 1 pint of cool water. Shake well. Strain. Salt and sweeten, if desired, to taste. Feed plain or with cereal-waters, or beef-juice.

**Toast-water.**—Pour 1 pint of boiling water over 1 large piece of well-browned toast made of stale bread. Stand five minutes. Strain. Salt to taste. Useful in diarrhea, given cold or hot.

**Lime-water.**—Piece of unslacked lime size of a walnut. Cover with water and mix well until thoroughly slacked. Allow to stand twenty-four hours. Decant. Filter.

**Junket.**—Warm 1 pint of milk, flavored with vanilla, if desired, to about 100° F. Divide into small glasses or cups. Stir quickly into each ¼ teaspoonful of liquid rennet or Fairchild's essence of pepsin. If it be desired not to divide into glasses, the milk, sugar, flavoring, and ferment (fʒj to fʒij to the pint) may be mixed together

and the whole heated to 100° F. in a double boiler. Remove and place on ice as soon as clotting occurs.

**Baked Apples.**—Wash apples well. Core them. Fill holes with sugar, and, if desired, a small piece of butter. Place in a pan, with a little water. Bake until soft. Serve plain or with cream and sugar. A useful dessert.

**Orange-juice.**—Slice an orange in half. Remove juice by hard pressure or lemon-squeezer. Strain to remove seeds and pulp. Given cold on an empty stomach. Antiscorbutic and laxative.

**Prune-water.**—Wash a pound of prunes clean. Cover with water. Boil one hour. Renew water of evaporation. Add no sugar. Strain. Laxative, antiscorbutic. Sugar may be added if desired. The prune-pulp is also a good laxative for older children.

**Acacia-water.**—Pour 1 pint of boiling water over 1 ounce of gum arabic and agitate until dissolved. Strain. May be used plain, cool, or be flavored with sugar, salt, orange- or lemon- juice. A small amount of brandy may also be added. Demulcent, febrifuge, thirst quencher.

**Gelatin.**—Soak the contents of 1 small package of Knox's gelatin for one hour in just enough water to cover it. Add 1 quart of boiling water. Stir until dissolved. Pinch of salt. Flavor with sherry wine, vanilla, or fruit-juice. Add sugar to the proper degree of sweetness. Set away to cool and thicken. A useful, cooling dessert. Has no nutritive value, but is filling and satisfying.

**Zweiback** may be made by rebaking stale bread or cake, or it may be purchased. It is a useful, easily digestible foodstuff, and is slightly laxative. It may be served dry or with butter, or, more commonly, with hot water and sugar.

**Holland Rusk** may be used as zweiback.

# CHAPTER IV.

## INFANTILE ATROPHY.

**Synonyms.**—Marasmus, Essential Marasmus, Decomposition, Infantile Wasting, Baby Consumption, Athrepsia.

**Definition.**—Marasmus should include only those cases of gradual but progressive loss of weight which depend upon the faulty assimilation of a food, faulty for the individual and administered over a comparatively prolonged period of time. All other instances of wasting occurring in infants are symptomatic of more or less tangible causes.

### PATHOLOGY.

In essential or dietetic marasmus there are neither gross nor microscopic demonstrable lesions which account for the symptoms. A further discussion as to the findings in a case dead from this disease would be time consuming and of no practical value. Those cases which exhibit tuberculosis, syphilis, chronic suppuration, acute sepsis of the newborn, obstructive pyloric disease or chronic meningitis, are not essential marasmus, but simply instances of wasting which are dependent upon any one of the factors aforementioned.

### ETIOLOGY.

**Predisposing Causes.**—Improper artificial feeding is responsible for the majority of cases. It usually follows the *causeless* withdrawal of the breast. Marasmus is rarely, if ever, met in the breast-fed. Personally I have never seen a case. Diarrheal diseases in the artificially reared, especially in those cases encountered in the summer months, often are

responsible for such an impaired nutritional state that the degree of food tolerance does not again extend beyond the minimum quantity, or at least does not reach the optimum amount necessary to sustain life and to provide for gain. Many of these cases develop marasmus because the functional activity of the glands of the gastrointestinal tract has been so perverted that no food could subsequently be found which could again properly activate them to produce normal ferments. Hence normal digestion could not occur and assimilation of improper end-products was the final result. Recovery cannot ensue unless the proper food is found to normally activate these perverted glands.

Poverty and improper hygienic surroundings, vitiated atmosphere, personal neglect, and overcrowding are predisposing factors of prime importance, especially when combined with improper and irregular nourishment. Infants upon the breast will stand a wonderful amount of abuse and neglect. Remarkable specimens of babyhood are frequently encountered in the slums. These infants thrive in spite of filth and poverty, retaining in many instances the one human heritage of which a perverted and selfish social system cannot rob them—the milk from their mothers' breasts.

Complete the theft—deprive these poverty-stricken babies of human milk—and the joined forces of artificial feeding and squalor will produce numberless cases of marasmus and fill many unnecessary graves—permanent monuments of disgrace to our present-day, much-vaunted, but barbaric civilization! It is not, however, to be assumed that marasmus is not met among the rich. Here idleness, indolence, indifference, hysteria, selfishness, and ignorance, as surprising as it is common, deprive many an infant of the

better class, so called, of its rightful heritage of breast feeding.

The baneful results of overcrowding and of artificial feeding are nowhere better illustrated than in hospitals for infants. These babies do not receive a sufficient complement of fresh air. It is an impossibility for a nurse in charge of five or six babies, however willing she may be, to attend promptly to the personal and physical wants of her charges. Many of these babies do not receive their food properly warmed or the bottle is not held for them, and consequently the food becomes cold or the infant falls asleep with the meal unfinished, and the fact is not discovered until the time for the next feed arrives. The attending physician either can not or does not study carefully the individual nutritional demands or the peculiar digestive capacities of his charges. In a word, these babies lack mothering and detailed care, and they cease to gain. They lose, and speedily there is developed marasmus.

Ignorance as to the adaptability of the individual digestive apparatus to the various food elements may, on the part of the would-be dietitian, lead to serious digestive disorders which will eventuate in a perverted metabolism and marasmus. Thus, one infant may exhibit protein intolerance, another will be disturbed by fat, and yet another by sugar. Starch, fed in excess or over a prolonged period or exhibited without the additional food elements (protein, fat, sugar), may lead to such injury of the gastrointestinal mucosa as to prevent the proper assimilation of food. This is especially noted after summer diarrhea, where patients are for long periods kept upon cereal-waters (barley, rice, oatmeal) without the addition of milk (Mehlnährschaden—Czerny and Keller). Scrutiny of the stools and the charac-

ter of the symptomatology presented by the digestive organs will enable the practitioner to decide, in most instances, upon the mischief-making factor. (See Chapter II, page 104.)

Age in itself has no direct influence on the incidence of this disease, although most cases begin under 1 year. After dentition has proceeded to the appearance of five or six teeth the possibility of marasmus, unless unusual circumstances obtain, is extremely rare. Sex and race have no influence. Prematurity, usually associated with an undeveloped gastrointestinal mucosa and a deficient glandular system, leads to digestive difficulties, at times insurmountable, and upon these depends the development of marasmus.

**Exciting Cause.**—This is at present unknown. Many theories have been advanced, but none has received universal acceptance. The depressed nutritional state and diminished food tolerance probably result from a perverted body chemistry—a disturbed metabolism wherein the calories cannot be supplied to the individual in a digestible form so as to provide for growth as well as to maintain body temperature and tissue balance. Hence downtear exceeds upbuild, and the individual commences to feed upon his own stored tissues to furnish sufficient calories to sustain life. This perverted metabolism may be produced by an initially perverted activation of the salivary glands by a food improper for the individual. Thus results successively perverted activation of all the glands of the gastrointestinal tract. This idea may be amplified as follows:—

When the adult sees, thinks of, or tastes wholesome food, the functional activity of the salivary glands is inaugurated. This phenomenon, commonly known as "mouth watering," occurs as the result of stimulation of the nervous mechanism of the glands as the result of psychic or physical impulses.

transmitted through the sympathetic or sensory system. It may be assumed that this normal stimulation results in the elaboration of a saliva normal in every respect and capable of acting normally upon a normal food. The food thus prepared is swallowed. As the result of normal salivary digestion upon normal food, end-products, themselves normal in every respect, are formed. The entrance of these normal end-products into the stomach is responsible in turn for the normal activation of the glands of the gastric mucosa. These therefore produce a gastric secretion also normal. This, acting upon the partially digested food, and end-products of the salivary digestion, converts the whole into still further normal end-products characteristic of this stage of the digestive process. These, entering the duodenum, normally activate the pancreas and the liver, causing these glands to elaborate their secretions in no way perverted. These now continue their normal action upon the remaining food and end-products normal to this stage of digestion. The final whole now enters the intestines, the glands of which are normally stimulated likewise to produce a normal secretion which, again acting upon normal end-products, finally completes the process of digestion by the conversion of all remaining food and normal end-products into normal final products, which, absorbed by the normal intestinal mucosa, eventually reach the blood and tissues via liver and thoracic duct, and these, being normal in every way, not only provide for tissue upbuild and downtear, but for growth as well.

Now let us consider the reverse. The mere sight or smell, not alone the taste, of abnormal or unwholesome food (abnormal or unwholesome for the individual), not only perverts the salivary secretion, causing an inhibition, but

may even cause serious gastric and intestinal disturbances resulting at times in vomiting and diarrhea. In other words, if we substitute the word *unwholesome* for *wholesome* and *abnormal* for *normal* in the statements of the preceding paragraph, we may assume an hypothesis not at all unlikely in its applicability to the etiology of infantile atrophy. Primary abnormal stimulation by an unwholesome food produces the initial abnormal secretion and resulting abnormal end-product which, acting upon the whole line of gastric and intestinal glands, are the essential factors causing the production of abnormal secretions and end-products at each stage of the digestive process. Each abnormal end-product is responsible for the initiation of the abnormal glandular activation in each step following. The final product, when the end of the digestive process is reached, is abnormal for the individual—does not nourish him, *i.e.*, not only is down-tear and upbuild not secured, but growth is not inaugurated. Therefore the individual feeds upon his own tissues, loss ensues—atrophy, malnutrition, marasmus—decomposition becomes apparent.

That this is theory cannot be combated. That it may be sustained by clinical facts and circumstantial data is also true. One common clinical experience is sufficient to warrant its consideration. These cases of atrophy present neither a gross nor a microscopic anatomy as stated. No perverted or diseased state of the gastrointestinal mucosa is discernible. Therefore the productive element must reside in the food itself. In fact, it must be the food itself! This is substantiated by many cases which have run the gamut of formulas, food mixtures, and a score of physicians and pediatrists, reduced to actual skin and bone, are commonly revived by the substitution of proper food (proper for the

individual). In the majority of instances this food is breast milk or a fortunately thought-out milk adaptation. In other words, the cause and cure of the condition have been determined on the instant from which the infant commences to thrive—the proper food has been substituted to produce normal activation of the salivary glands initially, from which will follow in succession normal activation of the stomach, the pancreas, liver, and intestines. The end-product is correct and upbuild exceeds downtear. The tide is turned and the infant thrives. *In other words, the etiology of infant*

Fig. 26.—Essential marasmus.

*atrophy is the continuous use of a food faulty for the individual, and its successful therapy consists in finding the proper food for the individual—a responsibility often more readily stated than accomplished, and yet withal, the conditio sine qua non.*

## SYMPTOMS.

The clinical picture of infantile marasmus is typical and, when once seen, is indelibly impressed upon the memory. It must be remembered, however, that other conditions will bring about a state of wasting identical in all appearances to that which we now understand as essential dietetic marasmus. These infants (Figs. 26, 27, and 28) appear senile,

weazened, and shrunken. The entire face, including the forehead, is wrinkled. The wrinkles are intensified by crying and surrounding the mouth they assume the form of a parenthesis. The features are pointed. The cheek-bones are prominent. The eyes commonly appear large and bright. There is an absence of fat in the orbit. This causes the eyeballs to recede. Later the eyes may be covered by a thick scum of mucus. The tongue is often clean and presents a bright-red surface with swollen papillæ. It may be

Fig. 27.—Essential marasmus.

covered with milk-curds, or thrush. The buccal mucosa is pale. The sucking pads remain after every other vestige of subcutaneous fat is lost. The skin hangs in folds upon the arms and legs, especially at the axillæ and on the inner aspects of the thighs. The skin may be muddy and dark, or may be unusually transparent. The skin over the buttocks may be intact, but is often excoriated. These infants move their arms and legs slowly, sometimes appearing to do so with deliberation. On the other hand, they may lie quietly in their cribs, unless disturbed. In the beginning the cry is strong. Later it becomes whiny and, in fatal cases, just preceding dissolution, it may be hoarse and weak. The skin of the abdomen is loose and may be

readily wrinkled when gathered between the thumb and forefinger, on account of the loss of subcutaneous fat. The belly is often distended. If these infants are laid naked upon their backs and their legs extended, they give the appearance of a frog—wide abdomen, narrow hips, and skinny legs (Fig. 29).

The temperature is subnormal. This is an important diagnostic point. The pulse is normal. It may become weak and rapid.

Fig. 28.—Marasmus. Characteristic attitude and appearance. Poor circulation shown by cyanosis of feet.

Vomiting is a rare symptom. It is not an essential feature of the nosology of marasmus. It may result from an acute digestive disturbance or indicate the effect of a tangible etiologic factor, viz., excessive fat or sugar feeding (excessive for the individual). The bowels move from once to five times a day. The movements usually appear well digested. Often they are green and contain mucus and curds. This follows a dietary indiscretion. If fat has been fed in excess, they are greasy. The fat is recognized by its response to its various tests (Chapter I, page 33). The movements may be constipated and greasy, loose and greasy,

Fig. 29.—Frog appearance in essential marasmus. Note the wide and prominent belly, the narrow hips and skinny legs. This description is original with the author and has been of material assistance to him in teaching.

hard and friable, or may contain soap (Plate VII). If the curds be protein they respond readily to the tests for this substance (Chapter I). The stool is neutral or alkaline. Where excessive quantities of sugar are fed, the movements are watery and usually acid and excoriate the anal region.

The urine in most cases is normal. It may be concentrated and deposit urates and uric acid upon the diaper. In some constipated cases receiving too much fat it is ammoniacal.

The blood exhibits the evidences of a symptomatic anemia, and may appear unduly concentrated, the clotting time being shortened.

These babies often have a voracious appetite, sucking vigorously upon whatever is placed within their mouths. They frequently suck constantly upon the hand until the fingers become macerated and sore (Fig. 27). The stomach is dilated and may present undue motility. The heart and lungs present no abnormalities.

Where excessive starch (for the individual) causes the injury to the gastrointestinal mucosa (see Etiology, page 152), a peculiar type of atrophic infant is presented. The muscles are hypertonic. The tissues are dry and atrophied. The bowels are loose, the abdomen is distended, and anemia is marked. The etiologic factor, as provided by a history of prolonged starch feeding, must in this instance be known in order to conclude a proper diagnosis and to provide a proper therapy, viz., the exhibition of breast milk or of properly adapted cows' milk, and the exclusion of starch, at least for the time being. It must be remembered, however, that there are cases wherein an excessive starch diet is associated with an unusual increase in weight, due to the retention of water in the system. These babies are fat,

doughy, and present a tendency to secondary infection, corneal ulceration, bronchopneumonia, and skin lesions. Edema, unassociated with nephritis, is not uncommon, and depends upon hydremia (Fig. 30). If starch is withdrawn and milk added to the feeds, these infants lose weight. In the first instance, however, the loss is only temporary. A second and permanent gain is inaugurated finally when the gastrointestinal mucosa assumes its normal state. Those

Fig. 30.—Marasmus complicated by edema. Note the pits from pressure on the lower leg and thigh and also the edema of the dependent portion of the abdomen and of the face.

cases which present corneal ulcerations are frequently fatal (Czerny).

In yet another type, where atrophy is associated with hypertonicity, the physical appearance is not unlike that of tetany. The muscles are rigid and boardlike and the electrical excitability is materially increased. The head is often retracted. The stools frequently respond to the starch test with iodine.

The *weight curve* exhibits a gradual depression in all cases of marasmus. From 5 to 6 ounces per week is the

usual record of loss. At times there may be a week or two when the weight does not fall, but remains stationary, or there may be a gain of an ounce or two. Sudden losses are not common unless there occurs an attack of diarrhea or some other complication. Where edema is present, especially in moribund cases, a sudden rise in weight may be recorded. This should always be borne in mind, so that the mistake may not be made of regarding it as a turn for the better. In cases which do not recover, the loss in weight usually proceeds to the point where the infant averages between 6 and 7 pounds. It is also noted in some cases that when once the proper food is found, or a change is made from one formula to another, a rapid gain of from 6 to 10 ounces may be recorded within forty-eight or seventy-two hours. The infant shows marked evidences of improvement in every way. After a week or two, however, the usual gain is from 3 to 8 ounces per week.

## COMPLICATIONS.

*Sudden* and *unexpected death* may occur in these little babies when their condition seems to be no worse than it had been for some weeks previously. The spark of life has been fluttering for some time when, unexpectedly but quietly, the supply of fuel having been exhausted, without struggle, it gradually ceases to burn and life is extinct. This frequently happens during the night, and the infant is found dead in bed in the morning. *Hypostatic pneumonia* may develop as a terminal evidence of feeble circulation and of lying in the prone position for a long time. These infants are susceptible to cold, chilling of the surface, and to sudden changes in temperature. Hence *colds, rhinitis, bronchitis,* and *bronchopneumonia* occur. All are poorly borne and

frequently determine a fatal outcome. *Purpura,* affecting the skin of the lower thorax and abdomen, and appearing as a thickly scattered, fine eruption, occurs from two to three weeks before death, in many cases. I have never seen a recovery in which this symptom appeared. Should these cases develop an acute diarrheal condition, accompanied by severe straining, inguinal hernia may appear. In one case under my care, *strangulation* of a *hernia* occurred, and was successfully operated upon by Dr. Stillwell C. Burns. From the same cause *prolapsus ani* develops, and may be a troublesome though usually not a dangerous issue. *Anal excoriation* and severe irritation of the entire buttock may seriously incommode the infant and interfere with its quiet. *Stomatitis* and *thrush* are usually directly dependent upon faulty technique in the antiseptic toilet of the mouth. *Dermal irritations* of all varieties, *bed-sores, macerations, intertrigo, furunculosis, acute dermatitis* and *erysipelas* are avoidable, troublesome and sometimes dangerous occurrences in poorly kept cases. *Edema* occurs without nephritis and is an exceptionally interesting phenomenon, since its etiology is obscure (Fig. 30). It has been already referred to as being responsible for a sudden increase in the weight. It appears first in the extremities and is a terminal state. It spreads upward and may involve the abdominal wall or the entire body. The temperature is very much below normal and the urine is clear, limpid, and free of casts and albumin. Its supposed association with injury of the intestinal mucosa by starch (Mehlnärschaden) has been previously noted. Its dependence upon the retention of fluid within the tissues, on account of the presence of sugar and salt in them, has been maintained by some authors. Although in most instances indicating a fatal

outcome, I have seen this symptom, contrary to the foregoing view, entirely disappear following the daily injection, subcutaneously, of warm normal-salt solution. *Sclerema* and *scleroderma* may occur as prelethal conditions. *Scurvy* and *rickets* may be met as the result of carelessness in feeding proprietary foods or boiled preparations over too long a period of time without taking proper precautions.

### DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.

This must be made entirely by the exclusion of all other causes of wasting. There is usually a history of the groundless discontinuance of the breast, and the feeding in rapid succession of various milk formulas and a host of proprietary foods, some of which may agree and cause a temporary gain in weight. The mere presence of wasting does not, as we now understand it, necessarily mean marasmus. In my experience, the most common error in this connection is to regard wasting dependent upon hidden *chronic suppuration* and wasting dependent upon *pyloric obstruction* as marasmus. As an instance of the first circumstance there appeared at my clinic at the Lebanon Hospital, some years ago, an infant 16 months of age, wasted to skin and bone, in whom the diagnosis of marasmus had been made. The age of the child—16 months—and the presence of teeth led to the thought that some factor other than a dietetic error was operative. Fever and leucocytosis were absent. A careful physical examination led to the diagnosis of *encysted empyema,* which was verified by exploratory puncture. Operation was followed by complete recovery within three months. In this case the absence of fever and of leucocytosis, and also of a careful examination, in all probability caused the

empyema to be ignored. The two former were absent no doubt on account of the fact that the infant's strength and resisting power had been so vitally reduced that neither the heat centres nor the leucocytes could any longer be stimulated by the toxins of the invading organisms; or the system had become immune to this particular bacterium, for the condition had in all probability lasted for months. The age of the child, presence of teeth, and the previous history of a pneumonia should have led to a careful physical examination, if to nothing else.

I have seen wasting due to other forms of chronic suppuration—*double otitis media* of long standing, *chronic mastoid disease, pulmonary abscess*—diagnosed as simple marasmus and treated by formula. In one instance, in which death ensued, a fatal issue could have been avoided if the importance of the primary underlying factors had been appreciated. The mere mention of these facts should be sufficient to prevent the careful practitoner from falling into error.

I have seen 24 or more cases of pyloric obstruction of one type or another, and in each instance save 2 was the diagnosis of marasmus made. This is a grievous error, since non-surgical or surgical treatment will save the majority of these cases if they are promptly recognized. In marasmus, vomiting is rare. In pyloric obstructive disease, it is a prominent and early feature, propulsive in character, and occurring without apparent cause. It is especially suggestive in breast-fed babies, occurring immediately or a few weeks after birth. This vomiting is usually responsible for taking these babies from the breasts, and this fact in itself should always arouse suspicion. In pyloric disease, inquiry will determine that the bowel movements are constipated,

exceedingly small, infrequent, or entirely absent. Visible gastric peristaltic waves are present. The pylorus is frequently palpable. The administration of 10 grains of charcoal is followed by its delayed or non-appearance in the anal discharges and its recovery in the water following stomach wasting twenty-four hours later. The X-ray gives valuable information not only as to the presence of obstruction, but also as to the degree of patency of the pyloric orifice, although this examination is not essential to an accurate clinical diagnosis. In conclusion it may be stated that the only symptoms which pyloric disease has in common with marasmus are the progressive wasting and the subnormal temperature.

*Tuberculosis* may be a cause for wasting. The term "babies' consumption" may, with propriety, be applied to this condition, but not to "marasmus." Both terms are regarded by many of the laity as synonymous and, consequently, this idea is responsible not only for much confusion, but also for much unnecessary fear. Tuberculosis will be discovered by careful investigation of the lungs, glands, and bones in particular. Fever is a common possibility, but may be absent. A careful röntgenographic examination of the bronchial nodes may determine these to be tubercular and a cause for the wasting. The abdomen should also be thoroughly palpated for enlargements, and the result of a carefully performed von Pirquet or Moro test should not be ignored in coming to a correct conclusion.

*Syphilis,* without skin lesions, especially in the very young, causes not a few infants to rapidly shrivel and in outward aspect they closely resemble marasmus. At present the Wassermann test is of much value in detecting these cases. In other instances, where this cannot be made, re-

liance must be placed upon the history of frequent miscarriages, lesions upon the mother or father or both, or the appearance upon the infant of copper-colored eruptions, mucous patches around the anus or in the mouth, or of rhagades (cracks) about the corners of the mouth, and a chronic nasal discharge (snuffles), together with the common enlargement of one or both epitrochlear glands.

Acute but sluggish *sepsis of the newborn,* manifesting itself by slowly forming metastatic abscess—*e.g.,* infection

Fig. 31.—Atrophy or marasmus due to chronic cerebrospinal meningitis.

of the umbilical stump, retroumbilical abscess, peritonitis in the newborn following navel infection—is often associated with a shrivelling up process that gives to the infant a distinctly marantic appearance.

Cases of *cerebrospinal meningitis* (Fig. 31) frequently pass into a state of extreme emaciation when they do not succumb in the acute stage. This is especially true of basilar meningitis. Of course, in children beyond the stage of infancy the distinction from marasmus need not be made. In fact, if one bears in mind the history of the case, even in the very young, a mistake is hardly likely to occur, and the condition is mentioned merely to make the list of possibilities complete.

Finally it must be stated that *malignant disease* of any form affecting the young will be recognized by the presence of a growth, and the emphasis of local symptoms will direct the attention to the seat of the trouble.

## PROGNOSIS.

Many cases of marasmus recover completely, no vestige of the disease remaining in after-life. No case of marasmus should be regarded as hopeless until it is dead. Many marvellous transformations are wrought if the proper food can be quickly found. It may be said that the prognosis depends entirely upon the ease and facility with which the practitioner is able to adjust the food to the digestive capacity and to the nutritional demands of the individual. This responsibility is not always discharged without difficulty.

Favorable signs are: a speedy change in the stools for the better, if they have been abnormal; a small but appreciable gain in weight; a rise in temperature to normal or to a few tenths of a degree above this point. Unfavorable signs are: frequent digestive disturbances, vomiting, diarrhea; a persistence of the subnormal temperature; stationary weight or a loss in weight, and the appearance of edema or purpura. Complications, however trivial, especially respiratory or infectious, are badly borne. Speaking generally, it can be stated that the nearer the age approaches a year and the shorter the duration of the condition, the better is the prognosis. Environmental conditions and attention to details also materially influence the outcome in individual cases. The results of treatment in private cases are therefore better than in institutions.

## TREATMENT.

**Preventive.**—Disease will largely disappear when poverty and ignorance are no more! The incidence of marasmus will share in this general decadence of misery when society ceases to rob man of his right to toil and to share justly in the products of his labor, and no longer denies to his offspring the right to suck its mother's breast. So too, when physicians and mothers cease to advance their artificial and false ideas as to the feeding of infants, and discontinue to condemn without reason the human milk-supply in individual cases, and when manufacturers of patented foods cease in their efforts to dictate to physicians how to feed the infants of the land, the cases of marasmus will disappear. Baby-saving shows, mothers' clubs, neighborhood talks by competent nurses and physicians, and educational propaganda of every variety should be encouraged to instruct the motherhood of the country as to the necessity of conserving the human milk-supply, and as to the means of accomplishing it. Hospitalism should stop. The moment an infant has recovered from an acute infection, if this be the cause of its presence in the hospital, it should be removed therefrom to its home or to the country, and to its mother's breast. I am in full accord with the teachings of Henry Dwight Chapin on this point. If possible, during its stay in the hospital it should be nursed by its mother. When for a sufficient reason an infant is deprived of its mother's milk, every means should be exerted to provide it with clean cows' milk so adapted as to meet its digestive capabilities, and to provide it with sufficient calories to meet its nutritional requirements.

**Active Treatment.**—Marasmus should not, if possible, be treated in a hospital. From the preceding it may be cor-

rectly inferred that the mortality in institutions is higher than in private practice. Especially if the infant be under 6 months of age, every effort should be made to secure breast feeding. If its mother's milk is not available the milk of another woman should be provided. This is not always possible, however, among the poor, unless a volunteer be secured. If one woman does not supply sufficient milk, the milk of many healthy women, if obtainable, may be mixed together and fed whole or diluted by dropper or bottle. If all breast-milk feeding cannot be had, if it be at all possible, one or more feeds of human milk should be given in twenty-four hours. A case recently seen with Dr. J. Cohen illustrated the almost specific effect of breast milk. The marantic infant, 4 months of age, was one of twins. The patient was receiving cows' milk, diluted, and the other twin was upon the breast. This baby was fat and healthy; the other was in a dying condition. It was placed upon the breast and the healthy infant, having had a good start, was put upon carefully adapted cows' milk. The sick infant made a complete and brilliant recovery and the healthy infant was not harmed by the change. Among the well-to-do, wet-nurses, carefully examined, may be secured at various prices. Their services are often invaluable in turning the tide toward recovery. Even though the wet-nurse's milk is excellent, it must be stated that the employment of these women does not always bring peace and contentment into the home. On the contrary, the practice of wet-nursing is far different from the theory. Temperamental differences between the wet-nurse and the mother, together with household and domestic problems, often bring disaster to the arrangements when everything seems serene.

Good results, too, may be secured by artificial feeding.

Every effort should be made to study thoroughly the peculiarities of the individual infant, and to determine the food element or elements which may be the causative factor or factors. The essential thing is to individualize, and not to treat infants by the same routine or by one method or system of feeding. Another essential is to secure clean milk and to keep it clean. With this in view, careful attention should be given to nipples and bottles, proper refrigeration, amount to be fed, feeding interval, the time consumed in taking the meal, and to the use only of sterile diluents. As a general procedure I do not favor the recent fad of long-interval feeding, for the reason that my experience with the older method of every two hours up to 3 months, with from one to two feedings during the night; every two and one-half hours up to 6 months, and one or no feeding during the night; every three hours up to 9 months and every three and one-half hours after this time has demonstrated satisfactory results to me. I see no reason to change unless, in individual cases, where vomiting might be benefited by a prolongation of the interval. During the day an infant should be fed by the clock. It should be awakened for its food, the feeding interval being counted from the time it started its meal, not from the time at which it finished it. During the night it should not be disturbed at all for food unless it be very weak. The meal should not be given hurriedly—at least from fifteen to thirty minutes being consumed, depending upon the amount fed. The nipple should be removed from the mouth at the end of every third or fourth suck. The food should be kept warm and the bottle should be held for the baby, and it should not be permitted to sleep while being fed. The habit of regularity will soon be formed, and the little patient will regularly awaken for

its meal. The quantity fed varies as the appetite, the tolerance, and the digestive capacity. Some cases do well on small amounts frequently administered. This is true of cases which vomit, especially where the longer-interval feeding fails. Roughly, the quantity may be regulated according to the rules given in Chapter II, page 102.

It is well to calculate the caloric value of the daily quantity of food, for in this way we may know whether we are feeding above or below the food optimum. Thus may we in a sense prognosticate as to whether or not the food tolerance permits of the administration of sufficient calories. Not infrequently, in very wasted infants, a larger number of calories are required to secure a gain in weight than the somewhat arbitrary standard would indicate. (See Chapter II, page 82.)

Cases which exhibit *protein intolerance* may be handled in several ways. At the outset I wish to make it plain that my experience does not permit me to subscribe to the German view, that *unmodified* cows' curd is not only never harmful, but can be fed in almost incalculable amounts. I believe that *mechanically divided* cows' curd, or curd that has previously been *predigested or, both,* is not only harmless in individual cases, but of great value.

The *coagulable protein* may be entirely eliminated by the use of *whey*. With this method I have had little experience, and therefore can neither condemn nor praise it. It has never appealed to me, although some authors recommend its use and report very good results. It cannot be continued as a permanent food, as it is lacking in constructive elements. As soon as improvement is noted, additions of cream, from ½ to 1 dram at a time, should gradually be made. As tolerance is noted these quantities may

be increased. Instead of cream, slowly increasing amounts of whole milk may be added. It must be remembered that cream is but superfatted milk, and that whey contains some of the ferment which was used in its making. Therefore, unless the whey is previously heated to 150° F. to kill the ferment, either the cream or the milk will become coagulated. This may not cause any inconvenience as far as the infant is concerned, but may alarm the mother or the nurse, or the curds may not pass readily through the nipple. The whey must not, however, be heated above this or the lactalbumin will become coagulated. As soon as gain is inaugurated or it is seen that the *whey-and-cream* or the *whey-and-milk* mixture is tolerated, a gradual change should be made to dilutions of milk. These should be weak at first and later strengthened.

In selected cases I have had success with *Ramogen* manufactured by Prof. Biedert (Chapter III, page 129). It has been employed as a temporary food, and in some instances the results have been nothing short of brilliant. This is likewise true of *Somatose milk,* which resembles Ramogen, and also of condensed milk in selected cases of protein and fat intolerance. All of these preparations, however, are but temporary foods and must be safeguarded by antirachitic and antiscorbutic remedies as fruit- and animal-juices.

The character of the coagulable protein may be changed by *simple boiling of milk,* whole or diluted. The experimental work of Brennerman[1] and of Ibrahim seems to prove that the action of the gastric juice upon boiled milk is to cause the formation of curds distinctly softer and finer and more closely resembling those of human milk than the

[1] Journal A. M. A.

curd which is formed as the result of the action of the gastric juice upon uncooked milk. In most cases, however, the simple boiling of the milk, without other means of modification, in cases of cow-curd intolerance is insufficient to overcome the difficulty. In any case, boiling should not be too long continued on account of the possibility of scurvy or, if it must be continued over a reasonable length of time, fruit-juices and beef-juice should be administered.

The addition of *cereal-waters or gruels* made from arrowroot, barley, oatmeal, rice, or wheat-flour, *plain,* as advocated by Jacobi or *dextrinized* as advocated by H. D. Chapin, is an excellent means of causing the curd to become comminuted in the stomach and to materially assist in its digestion. Where there is a tendency to looseness of the bowels arrowroot, barley, rice or wheat may be used, but where costiveness predominates oatmeal should be the choice. If starch intolerance exists, as manifested by much flatulence, dextrinization of these waters or gruels may be employed. This is accomplished by the addition of some preparation of malt or by the use of Cereo, which is a glycerite of diastase and is made by the Cereo Company of Tappan, N. Y. This Company also manufactures a fine grade of cereal flours from which these waters or gruels may be made, but I have for years employed with satisfaction the simple grains (Chapter II, page 87). In cases of difficult protein digestion the use of Keller's Malt Soup is said to give brilliant results, especially where the atrophy is associated with an intensely ammoniacal urine. Southworth's recent experience with this substance, especially in hospital cases, has been extremely encouraging. Malt Soup closely resembles the dextrinized gruels as recommended by Chapin. Malt Soup preparations made in America by the

Maltine Company are now available. For a number of years, in cases where starch intolerance appeared conspicuous, I have diluted the completed cereal-water with 50 per cent. plain boiled water. Where I have wished to impress the character of the stools, I have employed these waters full strength as the diluent, entirely excluding plain water from the formula.

*Sodium citrate* will promote protein tolerance in some cases, especially where vomiting is present (Chapter II, page 109).

Of value in many instances is *pancreatization.* Other cases do not do so well upon milk or milk formulas ordinarily pancreatized. Of another form of pancreatization and curd modification that has given me much satisfaction I will speak presently. The feeding of pancreatized formulas must not be continued too long, as the digestive apparatus may be permanently weakened. The food is subjected to the action of the ferment for a period of from twenty to thirty minutes. If too long continued, excessive formation of peptone results and the preparation is made bitter. The time of pancreatization is gradually diminished and finally omitted (Chapter II, page 108).

In treating marasmus proper *parental intelligence* and *co-operation* are as essential as proper food manipulation. The necessary means to purchase the best milk or access to a free milk station are items of no mean importance. Unfortunately ignorance and poverty often prevail, and the physician must do the best he can with the means at hand. Under these conditions in particular, but also, among the well-to-do, where protein intolerance was present, and yet, where I felt it was necessary to feed protein in rather large amounts, I have had most happy results from *buttermilk*

*mixtures.* It requires very little intelligence for the mother to learn how to make the food. Another consideration of prime importance is its cheapness. My method of using this preparation is as follows: I first place the baby upon the buttermilk-and-flour mixture (Chapter III, page 123), omitting the sugar until the movements become normal. This is practically an eiweissmilch with the exception that it lacks the curd of an extra litre of milk and it contains flour. I now commence to add cane-sugar, running the amount up to fifteen and three-fourths teaspoonfuls to the two-quart mixture. If everything goes well, and usually the gain in weight is inaugurated after the addition of the sugar, I gradually add cream, first a half-dram to every other bottle, then to every bottle, and gradually increase the amount as long as tolerance is maintained. I am forced, from my results, to regard buttermilk feeding as an exceptionally valuable dietetic measure in marasmus. I have learned to depend upon it, as in many instances I am sure that it has saved lives. The mixture is, as before stated, easily made, but directions must be carefully followed. This is particularly true with reference to the constant stirring of the mixture during the second boiling (if it is employed in this manner, which I believe gives better results than when the second boiling is omitted), *i.e.*, after the buttermilk and flour and sugar solutions or the flour solution alone have been mixed together. Unless it is thoroughly stirred from the minute it is placed upon a low fire, unmanageable lumping will ensue. An infant may be kept on buttermilk for months provided antiscorbutic remedies, as beef-juice and vegetable broth or fruit-juices, are administered at suitable intervals. In conjunction codliver oil is valuable, especially when adminstered by inunction.

As soon as a substantial gain is recorded (3 to 5 pounds) gradual or instantaneous transference may be made to properly adapted formulas of whole milk. I cannot recommend this substance too highly if it be intelligently employed.

Instead of buttermilk and flour without sugar, *eiweissmilch* answers an admirable purpose in causing the stools to become constipated and normal in aspect. Gradually carbohydrate, in the form of cane-sugar or Dextri-Maltose, is added. After five to six weeks a prompt return is made to whole-milk dilutions. Eiweissmilch may not be convenient and may be difficult to make. The dried preparation of eiweissmilch on the market known as *Larosan* is extensively employed by Finkelstein himself, and gives good results. Personally I have had a limited experience with it. I have observed its use in Finkelstein's clinic in Berlin. There I witnessed some good effects in the exudative diathesis (*vide* Chapter XI, page 309) and in marasmus. The stools in diarrhea in which sugar is the active etiologic factor are also favorably influenced.

Asked to name one method of treating marasmus, where either protein or fat or both have given trouble, which I favor most or rather which has given me the best results, aside from buttermilk, I should unhesitatingly recommend the *use of some simple milk formula wherein the curd had been modified by the old-fashioned flour ball, with or without the addition of pancreatin, or by the use of Benger's Food,* which is flour ball containing pancreatin. While this is a proprietary its composition is clearly stated, and it is recommended as a milk modifier and not as a food. It simply represents an easy way of using flour ball without having to go to the trouble of making it. Either one of

these preparations may be added in the amount of from $2\frac{1}{2}$ to 5 per cent. of the total quantity of the formula. I find the former percentage to answer most purposes. The heating to which the milk is subjected also materially assists in the digestion of the curd. I have never seen a case of scurvy develop on account of the heating except in one instance where an unruly infant (Plate XI) refused to take fruit- or animal- juices. I believe this to be due to the fact that it has not been continued over too long a period and because fruit-juices, vegetable broth, and meat-juice are always used in conjunction with the milk feeding—one of them or all. The method of using flour ball or Benger's Food is described in Chapter III. The effect of both of these preparations upon the stools is rapid. The latter are changed within twenty-four to forty-eight hours into a light or golden-yellow mass of smooth, mushy consistency, with the characteristic slightly acid, not unpleasant odor of normal breast-milk stools. This effect is continuous. Vomiting is usually checked, although it may continue and be without serious significance, and a gain in weight is inaugurated. Both the Benger's Food and the flour ball, as soon as the indications permit, are gradually reduced and finally omitted. The heating, however, is continued for a week or so and then stopped.

The quantity and quality of the formula are increased as the appetite and digestive processes warrant. If constipation persists it may be materially lessened by the use of from 10 to 40 drops of Philip's Milk of Magnesia in each bottle, or in every other bottle, or but once daily according to the result obtained. Of late I have been favorably impressed by the use of the liquid paraffin preparations (Chapter VIII, page 254).

As to the character of the formula itself, *experience* and *personal equation* count for much. This statement is not made to sidestep the issue or on account of a desire to deny to the practitioner a clear exposition of the details of formula manipulation, but simply because it is a fact learned from large experience. It must, however, be stated as a truism that as good results may be obtained by the simple dilution of whole milk or of skimmed milk as with any other method. One should start with a strength of about one-fourth milk and three-fourths diluent and gradually increase the quantity of milk. *The key to the entire situation is provided by a careful study of the stools, and the adaptation of the strength of the formula to the digestive capacity.* The method of dilution or of modification is really a matter of secondary importance. The physician must simply be able to increase or diminish the coagulable protein or any other of the food elements according to the indication. It cannot be too strongly emphasized that success depends upon the ability to individualize.

If the cause of the digestive disturbance be *fat intolerance* (Chapter II, page 110), *whey* may be employed for a short time. It contains a little less than 1 per cent. of fat. To it may be added gradually increasing amounts of skimmed milk.

In other instances signal success has been achieved by the use of *diluted whole milk* or *diluted skimmed milk.* In all cases where skimmed milk is employed, it should be obtained by skimming the best obtainable whole milk, at home, after the cream is permitted to thoroughly rise. As tolerance is established one-fourth, one-half, and then three-fourths of the cream, which has been removed, may be poured back into the jar and the whole well shaken and

then diluted to any strength, or any of these preparations may be pancreatized or modified by flour ball and pancreatin or by Benger's Food. The pancreatin in each instances acts upon the fat by reason of the steapsin which it contains. In using pancreatin only the best possible product should be employed and pains should be taken to see that it is strictly fresh. That manufactured by Fairchild Bros. and Foster has given me satisfaction. Buttermilk with flour and sugar or eiweissmilch with additional carbohydrates are also exceptionally valuable in cases of fat intolerance, especially the former, since both are weak in fat.

If cane-sugar be employed to supply the extra carbohydrate, rarely will any disturbance attributable to *this* source be demonstrable. Jacobi for years has advocated the use of this chemical in preference to milk-sugar, and my experience bears out the validity of his teachings. Of late, the malt-sugar preparations have come into prominence by reason of the impetus given them by the German school of pediatrists. They owe their popularity to the fact that they often cause a rapid and permanent increase in weight because maltose, which they are all said to contain in about the proportion of 50 per cent., is readily absorbed and rapidly assimilated by the tissues. The muscle and body juices contain a maltose-splitting ferment, and therefore any maltose absorbed as such is converted after it leaves the intestinal canal and is not again eliminated as maltose. On the other hand, lactose and saccharose, when fed in excessive amounts, are eliminated in the urine, not being converted in the tissues. Maltose is said to be twice as assimilable as either of these two. Mead-Johnson's Dextri-Maltose, Loeflund's Food Maltose, and Soxhlet's Nährzucker are practically identical in composition. The first is more avail-

able on account of its comparative cheapness. These preparations are used in the same strength as either lactose or saccharose, being added in the strength of from 1 to 5 per cent.

If sugar is not borne well at all, buttermilk plain, or buttermilk with flour, but without sugar, or eiweissmilch furnishes the means of giving nutriment with a minimum of this substance. Additional sweetness may be secured by adding 1 grain of saccharin to the quart. Gradually, extra carbohydrate is added. Cases which do not tolerate sugar well suffer especially from a subnormal temperature when deprived of this element, and therefore must receive extra care by being protected with proper clothing and external heat.

Where the history provides the evidences of starch injury, I. A. Abt[2] recommends milk containing a moderate amount of fat and the withdrawal of carbohydrate food, especially buttermilk mixtures, malt-soup, and cereal decoctions. If possible to secure it, breast milk offers the greatest chance for recovery. It is administered first in small quantities. The primary withdrawal of starch may, especially in the hydremic types, cause an initial loss in weight. Next to breast milk undiluted cows' milk, at first in small and then in gradually increasing amounts, is recommended. Tea or water sweetened with saccharin (gr. j to the quart) may be administered to supply fluid. Care should be taken not to exceed the infant's tolerance for fats or, in fact, protein and sugar as well, as it must be remembered that the injury produced by the prolonged feeding of starch has impaired the tolerance for all the food elements.

[2] Journal A. M. A., October 4, 1913, p. 1276.

**Food Preparations Other Than Milk.**—Useful in the treatment of marasmus are beef-juice, freshly made as directed on page 145, Chapter III, or Valentine's meat-juice, fruit-juices—from oranges, grapes, or prunes stewed without sugar. Vegetable broths and olive oil are also useful.

Meat-juices or fruit-juices are best administered, in small amounts, *exactly one-half hour before* feeding time. This permits the juice to enter the stomach after it is empty. The previous meal has, under normal conditions, practically passed out and entered the duodenum; hence there is no admixture of meat and milk—a scientific adaptation of the Mosaic law which finds modern verification for its originally physical, though Biblical, basis.

Vegetable broth (Chapter III, page 146) is used as a drink. It is usually acceptable to the infant. Sometimes it is not. It is a valuable antiscorbutic, antirachitic, antiexudative, antacid, and laxative remedy. Its use, however, should not be forced. In fact, this is true of any remedy or any food.

Olive oil in doses of ½ to 1 fluidram is sometimes well tolerated where the fat of cows' milk cannot be digested. It is best given one-half hour after feeding, especially where skimmed-milk preparations are used as food.

*Rectal alimentation* with small amounts of pancreatized milk, and whisky ♏x to ♏xx, administered once or twice in twenty-four hours high into the bowel, and previously warmed and following a cleansing enema, may be useful in cases of extreme asthenia as a life-saving agent.

*Hypodermoclysis* with normal saline solution, properly warmed and administered in amounts varying from 2 to 5 ounces and under strictly aseptic conditions, and not oftener than once in twenty-four hours, is a useful remedy (Chap-

ter XIII). This is especially so in those cases of atrophy which have followed an attack of summer diarrhea (milk intoxication) and in which the onset has been rather abrupt. The tissues have been speedily dehydrated and demineralized by the tremendous loss of water per rectum.

## HYGIENIC MANAGEMENT.

These babies do better in a warm atmosphere of pure air. As before stated, they should not be kept in hospitals. If orphans are deserted, they should be placed in homes, if possible, especially if the caretaker can at the same time give them the breast. The municipality should thus provide home shelter wherever possible for its infant charges rather than maintain them in almshouses.

Regularity in feeding, feeding proper quantities, neither too fast nor too slow, proper warming of the bottle and attention to the minutest detail, which may be included in the expression "intelligent and wholesome care," should be provided.

## DRUG THERAPY.

Drugs occupy a position decidedly subordinate to the dietetic and hygienic management of these cases. There are no specifics. Extract of thyroid has been recommended as well as extract of thymus. I have had little experience with the former and none with the latter. Thyroid, in my hands, has given no indication of its usefulness. On the other hand, Henry Heiman, in a personal communication, recommends its use empirically in certain cases which cannot be classified. He administers it in the dose of from ½ to 1 grain three times a day. It is my belief that the physician who leans upon any drug therapy in this condition, to

the exclusion of the application of his knowledge of dietetic detail and individualization, will have poor results. Tincture of nux vomica in ♏j to ♏ij doses t. i. d., a. c., may be useful to increase the appetite and the motor function of the gastrointestinal tract. Extract of pancreatin and taka-diastase, alone or in combination, and rubbed up with 5 grains of white sugar may assist in protein and fat digestion. Paraf Javal's solution of strontium bromid may relieve colic, vomiting, and flatulency. A peaceful night may be secured by a single or double dose of

℞ Sodii bromidi ........................ gr. ij.<br>
Tr. opii camph., ...................... ♏ij.<br>
Syr. simpl.,<br>
Aquæ menthæ pip., or<br>
Aquæ camph., or<br>
Aquæ anisi ........................āā q. s. ad fʒj.

A few drops of HCl dil. ♏iij-v may assist in the digestion of curd and prevent fermentation. An initial dose of castor oil and spiced syrup of rhubarb, equal parts, will cleanse the bowels, relieve fermentative diarrhea, and is often of service. Later it may be followed by small doses of aromatic cascara for its tonic effect. Constipation may further be relieved by suppositories, enemas of olive oil or glycerin-and-soap water, and by the use of liquid paraffin preparations as before stated. Likewise it may be repeated that codliver oil, by inunction, is a valuable agent.

# CHAPTER V.

## RICKETS.

**Synonyms.**—Rachitis, English Disease.

**Definition.**—Rickets is a general disease occurring as the result of a perverted metabolism, the exact nature of which is not at present entirely understood. It manifests itself clinically by changes in the osseous, muscular, nervous, and digestive systems.

### PATHOLOGY.

While rickets depends upon some form of toxemia or metabolic disturbance which involves primarily the nervous, digestive, muscular, and osseous systems, the lesions characteristic of the disease are found only in the bones. Whether these changes are inflammatory or not is still a matter for discussion. The most marked changes are in the long bones and occur in the bone-forming centers, *i.e.*, in the cartilage between the shaft and the epiphysis, and in the bone-forming or inner layer of the periosteum, and in the inner layers of bone which lie next to the medullary canal. In all these situations except in the neighborhood of the medullary canal, in health there occurs proliferation of cells which are later replaced by bone. This is accomplished by the deposition of inorganic substances. In this way the long bones grow in length and in thickness. The medullary canal is widened by the absorption of the layers of bone found in this situation.

In rickets there occurs increased activity in the proliferation of cells in the hyaline cartilage between the epiph-

ysis and the shaft and in the inner layer of the periosteum. There also occurs absorption in the medullary region, but decidedly less rapidly than in health. In addition there is an intense increase in the vascularization of the parts and there is a diminution in the deposition of inorganic matter, *i.e.*, the quantity of organic matter far exceeds the inorganic. Thus the process occurring in health is reversed. The medullary canal becomes filled with rapidly proliferating cells that resemble granulation tissue. It can be seen, therefore, that as a result of this increase in cell proliferation and in the lack of inorganic matter the epiphyses will become enlarged and thickened. Also the surface of the long bones will become irregular and the bones will readily yield to the effects of muscular traction, gravity, and atmospheric pressure. These bones also readily bend or, if fracture occurs, it will not be complete, but will be of the "green stick" variety.

The same process of cell proliferation and of increased vascularization, together with a scarcity of mineral constituents, takes place in the centers of ossification of the flat bones. This is especially true of the cranial bones. This gives rise to the formation of areas of thickness, or bosses. In those areas where the formation of bosses is absent, absolute or relative thinning of the bone results in craniotabes.

The rachitic processes may become arrested at any time and complete absorption with perfect restoration to the normal will occur. In fact it may be impossible to recognize that the present adult was a rachitic infant. The deposition of inorganic substances may proceed to such a degree as to cause the bone to become unusually hard or ivorylike (ebonization).

## ETIOLOGY.

This disease is confined almost exclusively to infants who are *artificially* fed. When it occurs in the breast-fed it does not appear until late in infancy. Its incidence in these babies is evident beyond the first year, *i.e.*, in infants who have been kept upon the breast too long and who are therefore receiving food deficient usually in the elements which are essential to a vigorous metabolism. Just what exists in breast milk that prevents, and what is absent or present in cows' milk which permits or causes the symptoms of rickets to appear, has not been clearly defined. It may be that the frequent disturbances of digestion to which artificially reared babies are prone, give rise to the development of enteric fermentation and the subsequent formation of toxins which, circulating in the blood, exert their deleterious effects upon metabolism and nutrition, preventing the normal development of nervous, muscular, and osseous tissue. Certain it is that clinical experience emphasizes the frequent occurrence of rickets in individuals who receive a *deficiency of fat and protein* either by accident or through intention, the latter necessitated by the fact that the digestive powers are deficient in their ability to take care of these substances. Thus, where mixtures low in fat or low in protein are fed over a long period of time, rickets is likely to develop. Therefore infants who are continuously fed upon *condensed milk,* which is notoriously deficient in these substances and in mineral constituents as well, containing at the same time an excessive amount of carbohydrate (sugar), are frequently victims of this disease. Without protein and fat, normal development of bone, muscle, and nervous tissues cannot occur. In rickets these are uniformly affected and exhibit a physical weakness and irri-

tability that cannot be readily accounted for in any other way.

*Fat and protein deficiency* may occur not only, as just stated, as the result of a food mixture weak in these substances, but may supervene as well where the formula for some reason disagrees and at the same time contains not only a sufficiency of the food elements, but an excess. In the first instance they may be *deficient for the individual.* The personal equation therefore or the individual's idiosyncrasy must be considered in coming to a correct conclusion. In the latter instance the deficiency depends upon some digestive disturbance due to the *excess per se,* or upon intolerance of some other element, notably *carbohydrate.* In either instance the resultant is malassimilation—an amount of fat or protein deficient for the individual's proper metabolism being absorbed.

A *deficiency of lime salts* in the diet could readily account for the state of hyperirritability of the nervous system in rickety infants who are so eminently liable to convulsion. Lime is a nerve sedative. The salts of sodium and potassium are responsible frequently for nervous excitability. Therefore any food lacking a sufficient amount of calcium may predispose to this disease. The deficiency of lime in the tissues, theoretically at least, may be produced as in the case of fat and protein, by its *absence or deficiency in the food,* or by the *failure of the organism to assimilate it sufficiently,* or by its *increased elimination from the body.* The last depends upon the ease with which it could combine with the active agent, presuming this to be an acid, responsible for the disease; or it may be due to the untoward influence of diseased or functionally perverted parathyroids upon the maintenance of a proper calcium balance.

The *frequent association of rickets with tuberculosis* or, rather, the common occurrence of tubercular lesions in rachitic children, is an ordinary clinical experience that requires no special emphasis. However, the degree of interdependence of these two diseases is not clear except in so far as it is a matter of common knowledge that all infections are not only more likely to occur in the rachitic, but that they are marked by greater severity. Consequently, under these circumstances, these diseases offer a graver prognosis. In a word, the resistance is lowered in rickets and it is readily understood that the vitality may speedily be vitiated by a deficiency, especially of protein and of fat as well.

A factor of prime importance in its bearing upon the development of rickets is provided by *faulty hygiene.* Overcrowding, improper clothing, deficient aëration and sunshine are peculiarly common to those in whom this disease appears with the greatest frequency. It may be that the frequent association of rickets and of tuberculosis finds its origin in the single etiologic factor of faulty hygiene, and this symbiosis, as it were, may represent nothing more than a coincidence in that the same factor provides a comfortable habitat for the exciting cause of each.

*Race* has its influence too. The disease in America is met decidedly most often in the *Negro* and next in the *Italian* immigrant. The filth and poor rearing of the former, and both these factors together with the excessively starchy diet of the latter, evidently provide sufficient reasons for the development of this disease. From this, however, it cannot be concluded that the rich are immune to rickets, although its incidence is decidedly less where material assets are sufficient to provide for the ordinary and the extraordinary requirements of existence.

*Sex* has no bearing on the frequency of rickets and *heredity* is without influence. The occurrence of several subsequent cases of this disease in all or in a part of the children of one family can be explained by the continuous presence of the same predisposing and exciting factors.

As to *age,* it must be stated that we are dealing here with rickets as we commonly see it in practice, and not with those questionable types of the disease (achondroplasia, fetal rickets) which depend upon some obscure uterine influence. Nor do I intend to dwell upon the rickets of puberty, but to confine the description to a consideration of the disease as it is met in infancy and in childhood. It is rare in very early infancy. It may appear at 3 months. It is more likely to occur after 6 months and to manifest itself more frankly after 1 year of age. It is important to remember that the initial symptoms of the disease, to which reference will again be made, frequently appear quite early. These symptoms are mild at first and are therefore frequently unrecognized. My purpose in emphasizing this fact depends upon a desire to insist upon our ability to abort the further development of this disease. If the proper hygienic and dietetic measures are inaugurated as soon as the significance of these initial features are recognized and appreciated, this statement becomes a truism. If the infant escapes, it is rarely possible that the condition will begin in childhood, *i.e.,* after 2 years.

*Among predisposing factors* of important moment, in fact regarded by some authors as sufficiently influential to be included among the most important exciting causes, is a *deficiency of sunshine, fresh air, and the presence of damp surroundings,*—in a word, as before stated, a vicious hygienic environment. While it is true that the whole

economy is depressed and vitiated by such influences and therefore predisposed to any disease, infectious or otherwise, we cannot help but recognize the presence of some other factor as the active agent. All children subjected to such influences do not develop rickets and many acquire the disease who are not so surrounded. While the disease occurs with greater frequency among the poor, it is also found quite commonly among the rich, and in the former instance its more frequent incidence is perhaps relative. *Rickets is undoubtedly a disease of metabolism and diet. All other etiologic influences are predisposing and not active.*

## SYMPTOMS.

The most apparent symptoms of a well-developed case of this affection are referred to the *osseous system.* If, however, careful investigation be made, certain other features may be detected early and protective measures be instituted to prevent the further development of the disease. This statement needs qualification, as it is possible that the process may be *spontaneously arrested* at any time. It is not always safe therefore to conclude that the cessation of symptoms depends upon any therapeutic or dietetic measures which have been instituted. Nevertheless it is a clinical fact readily demonstrable by extended experience that, if certain precautionary measures, which will be pointed out later, are thrown about individual cases of artificial feeding, rickets need not and does not develop.

Among the earliest evidences of a rachitic tendency, *headsweating* occurs with much frequency. It is not pathognomonic in itself, as it may occur in healthy babies, but when associated with other conditions is eminently suggestive. The sweating may be confined to the forehead

or it may involve the occipital portions as well. It commonly occurs during the act of nursing and especially during sleep. It may be so profuse as to cause a corona of dampness to surround the spot where the head comes in contact with the pillow. *Seasonal influences* have no bearing upon its presence. It is continued well into childhood and may, in conjunction with draughts and sudden exposures, be responsible for some of the congestive and infectious accompaniments or sequences of the disease (colds, pneumonia, bronchitis, etc.).

*Craniotabes,* or the thinning of the skull in spots, appears in some instances as early as the third month and is said, in a so-called congenital form, to even precede this age. Of this variety of rickets I have met but few instances. Craniotabes may affect the parietal and frontal bones, but more commonly involves the perpendicular portion of the occiput. This is often flattened by the pressure of the head upon the pillow, and over the flattened area the hair is commonly worn away. This flatness must be distinguished from family resemblances and, before it is said to be due to rickets, the head of the mother and especially that of the father, should be visualized. This symptom appears early, but is continued throughout the attack. When associated with an increase in the parietal and frontal eminences, which occurs as the result of an actual deposition of bone, and which does not appear, as a rule, until after 6 or 8 months, the head assumes the characteristic square appearance which is distinctive of the disease (Fig. 32). The circumference of the skull is increased.

In young infants it is well to remember, especially after severe labor or in instrumental cases, that the shape of the head may become irregular or flattened as the result of

molding or of pressure of the forceps. This change in contour, also, may persist for some weeks or months. In fact in non-rachitic breast-fed babies of vigorous develop-

Fig. 32.—Square outline of head in rickets.

ment, I have noted it as late as 8 months, and I have an impression that it may be permanent without causing any harm to the brain. This should be borne in mind when

deciding individual instances as to their rachitic or non-rachitic origin, and a careful history of the character of the labor should therefore be elicited.

During early infancy and also throughout the attack, *digestive disturbances* are common. In themselves they present nothing characteristic of the disease, and whether they appear as a part of rickets or as interloping symptoms, or as a consequence of it or even if they possess an etiologic influence, is not clear in the nosology of this affection. Certain it is, however, that rarely is there met a case of rickets in which, at some time during or throughout the milk-feeding period at least, that digestive orders of one type or another are absent. Constipation is the more common type of trouble, or this may alternate with diarrhea in which the stools present features of fermentation and non-digestion. Vomiting is rare. The stools are often fetid. If constipated, they may appear hard and nodular. As has been stated, it cannot be determined with positiveness that these digestive crises possess an etiologic influence. There is no doubt, however, that, at least in a measure, they are responsible for the evidences of toxemia which are common to rickets and which show themselves, as will be detailed later, by nervous hyperirritability with a tendency toward convulsive seizures.

The *liver and spleen* are quite commonly enlarged. More significance attaches to the latter than to the former. It is difficult to determine whether splenic enlargement is an essential feature of the disease. My impression is that it is not, but that it depends upon toxemia, probably of intestinal origin, or it may be secondary to a tuberculous process to which rachitic children are so frequently subject. *Polyglandular enlargement* occurs, too, with considerable fre-

quency. The postcervical glands are palpable, as are the glands of the axillæ and those in the region of the groin. Undoubtedly, in many instances, the enlargements are tubercular, but not infrequently they represent simply the evidences of general toxemia.

*Dentition* is delayed in those cases in which the rickets appears before the time usually recognized as the physiologic period at which teething should be inaugurated (6 to 8 months). If the disease appear after this time the two lower central incisors may already have erupted. This must not be taken as a sign that rickets does not exist. This important diagnostic point receives emphasis from Zappert. The subsequent dentition is delayed. Dentition is often irregular and rickety children may—although care must be exercised in coming to this conclusion, which should be reached only after every other possible etiologic influence has been eliminated—suffer from reflex disturbances directly due to teething, on account of the hyperexcitability of the nervous system. The slight irritation may be sufficient to produce irritability, nervousness, changes in disposition, rises in temperature, slight congestions, as coughs, otitis, and conjunctivitis. I know this is a dangerous dictum to put into the hands of the general practitioner and am conscious that it has been combated by much eminent authority. I feel, however, convinced, from cases which I have carefully studied, that, at times at least, dentition and rickets produce a combination of etiologic factors which may be responsible for the conditions noted. At least no other factor was demonstrable and recovery was hastened, if not produced, by gum lancing.

*Muscular weakness,* to which reference will again be made, manifests itself early. There is lacking a feeling of

tone, and this is evidenced by the inability of the baby to support its head upon the shoulders and by the backward curvature (rachitic kyphosis) of the spine when the infant is held in the sitting posture (Fig. 33). Ordinarily an infant should be able to support its head by the end of the second or third month. While the absence of the power so to do is not pathognomonic of rickets, it occurring in other conditions (hydrocephalus and amaurotic family idiocy), its association with the other symptoms enumerated forms a highly suggestive phenomenon.

*An ammoniacal urine* is a common occurrence in artificially reared infants. It results, in all probability, from the excessive feeding of fats and sugars whereby these substances are but partly transformed by the digestive glands. This results in the formation and absorption of fatty and other acids which combine with the alkaline bases of the body, producing an alkaline reaction of the urine and an increase in the ammonium output. This condition is especially common in infants who show the other symptoms of early rickets. This statement must not be taken as a contradiction of the theory which emphasizes the possible etiologic effect of the deficiency of fat. On the contrary it accentuates its possible truth, viz., an excessive amount of fat may be fed to the infant and yet its economy may receive a minimum amount on account of its perverted transformation in the gut.

The following symptoms, therefore, characterize the symptom-complex of early rickets, and may be nominated the *premonitory features* of the disease,—not that it has not been already inaugurated, but that the progress may, in a sense, be halted by proper management. They are: *head-sweating, craniotabes, digestive disturbances, constipation,*

Fig. 33.—Rachitic kyphosis.

*late dentition, nervous irritability, muscular weakness, and ammoniacal urine.* Craniotabes alone is characteristic. The rest, individually, signify nothing, but the entire ensemble constitutes an entity of convincing interest.

Fig. 34.—Rickets. Bulging forehead, enlarged radii, pot belly, skinny legs, weak muscles (notice child cannot stand), flat-foot.

### OSSEOUS CHANGES.

Other changes in the skull besides craniotabes occur. Great interest attaches to the *anterior fontanelle.* In rachitic infants, up to a certain age, this progressively in-

creases in size with the growth of the head. Ordinarily it should be closed by the eighteenth month. Ossification in rachitic children is delayed beyond this period, sometimes extending well into the second year. While the membrane does not budge, the cranial pulsation may be distinctly felt. The *sagittal* and *frontal sutures* likewise remain open. The forehead at times bulges and the frontal eminences are prominent (Fig. 34). The facial bones are also involved,

Fig. 35.—Rachitic rosary.

especially the superior maxilla. The palate consequently presents a highly arched appearance.

**Chest.**—The *clavicles* frequently present abnormal curvatures. The *sternum* is not uncommonly depressed below the surface, causing the characteristic "chicken-breast" appearance or it may be unduly prominent, when the child is said to be "pigeon-breasted." The *ribs* show changes which possess considerable diagnostic import. At the costochondral junction enlargements appear which may not only be palpated, but which are distinctly visible. This is called "beading" or the "rachitic rosary" (Fig. 35). This is only produced by rickets. It must be borne in mind,

however, that in emaciated infants the costochondral junction is always visible, and care must be taken not to regard this as rachitic unless there occurs distinct enlargement. The rosary may be present as early as the third or fourth month.

The whole chest, as a rule, is flattened and narrow, especially in the upper portion. The lower portion flares outwardly and may appear actually everted. This causes the formation of a depression running outward and downward and involving usually the ninth, tenth, and eleventh ribs. It constitutes what is known as *Harrison's groove.* The amount of breathing space is limited on account of the flattening of the chest. This causes an improper development of the lungs and may constitute a potent factor in the occurrence of those pulmonary infections to which rachitic children are usually subject. Irregular malformation of the chest may appear. One side may be prominent, the other flat, and serious depressions may be present.

The *spine* presents abnormal curvatures. Rachitic kyphosis has already been mentioned. Scoliosis is common and results directly from muscular traction upon the softened bones (Fig. 36). These curves may become accentuated after the child begins to walk. The rachitic curve, of whatever nature, is graded and can usually be made to disappear unless too far advanced, by causing the child to lie upon its stomach or to bend far forward. The curve involves many vertebræ. These characteristics distinguish the rachitic kyphosis from that produced by tuberculosis of the spine, in which the backward curvature is angular, not gradual, involving but two vertebræ as a rule and is fixed (Fig. 37), *i.e.*, cannot be made to disappear by causing the child to lie upon its stomach or to bend far forward. In

PLATE XI

Tubercular kyphosis. The curve involves two vertebræ. In rickets usually four or five are involved and the curve is gradual.

doubtful instances, an X-ray study is often of great assistance in making this important differentiation (Plate XI).

The rachitic *pelvis* is flat and the anteroposterior

Fig. 36.—Rachitic scoliosis.

diameter is considerably shortened. This type of pelvis, together with spondylolisthesis, may, in later life, give rise to serious obstetric complications. The pelvis is often nar-

rowed laterally and may be so obliquely, due to the development of deformity more on one side than upon another as the result of muscular traction and pressure after the weight of the body rests upon the undeveloped legs.

The *legs* of the rachitic *infant* are not commonly curved, although they may be. The normal bowing of the legs of the newborn infant must not be confused with rickets. The legs are small and undeveloped. In an infant 18 months or 2 years of age they usually have the development of an infant 6 to 8 months of age (Fig. 34). The legs are small, flabby and hypotonic, and the reason for the inability to walk is readily recognized. As a rule the deformities do not appear until the weight of the body is supported by the legs, being directly due to the combined effect of pressure and muscular traction upon the softened bones. Flat-foot also occurs (Fig. 34). The epiphyses, just above the ankles, are commonly enlarged, but not to the same extent as the epiphyses of the forearms. The femur is rarely involved alone, although I have witnessed an almost complete spiral twist involving one femur. Anterior bowing of this bone is common.

The deformities of the lower extremities may be worse on one side than on the other and they may assume many forms. For simplicity, however, the classification of Comby is exceptionally original and instructive. He causes the following figures and letters to represent the more common deformities: ( ), parenthesis or O legs represent bow-legs, or genu varum (Fig. 38); capital X, knock-knee, or genu valgum; K, unilateral genu valgum; D, unilateral genu varum (Zappert). Anterior bowing of the tibia is a common deformity (Fig. 39).

The *upper extremities* are also involved. The humerus

Fig. 37.—Tubercular kyphosis, showing the sharpness of the spinal curvature. Compare with X-ray (Plate XI) of similar case in another patient.

may present thickenings and curves, but the greatest interest attaches to the forearms, especially the radii. The forearm may be bowed. The radii commonly present an enlargement of the epiphyses just above the wrists (Fig.

Fig. 38.—Pot belly and bow-legs.

34). These enlargements may be slight or very prominent and are pathognomonic of the disease. Although it does not assume the same prominence as it does in scurvy, tenderness of the bones occurs and may cause the child to cry when handled.

The bony changes are progressive, but may, as previously stated, become arrested at any time. After recovery they may entirely disappear. On the contrary, they may persist into adult life and thus may be afforded an instance

Fig. 39.—Rickets. Anterior bowing of tibia and pot belly.

of the hereditary influence in those cases where these changes, especially of the head, are visible in one or other parent or in an older child. Hereditary influence is not, however, always easily traced, for the reason, as stated before, that in a single family or in a single race or section

of the country the same etiologic or environmental forces may be operative. The bones become unusually hard in instances wherein the deformities persist beyond the sixth year. It is noteworthy, however, that in races in which rickets is common, especially in the colored race, in which nearly every child at some period of its development exhibits some type of rachitic deformity, slight or severe, very little evidence of the early presence of the affection can be noted in the adult. Neither do negro women suffer from obstetric complications more frequently than do white females.

*Rachitis of adolescence* is a form of the disease which has its incidence about the age of puberty. It is little understood. The symptoms, affecting commonly the legs of growing boys, which may become bowed or knock-kneed, appear at the time of heightened physiologic activity when changes are noted in the voice, when growth appears to be stimulated, and when hair appears upon the face, under the axillæ, and over the pubic region. Flat-foot may develop at this time. So-called "growing pains" may be present, although care must be exercised, otherwise an insidious attack of rheumatism may be ignored and be only recognized when the distinctive heart-murmur occurs. I should say that growing pains are more commonly rheumatic than rachitic.

## MUSCULAR WEAKNESS.

This is an early and valuable sign of the disease, and its etiologic influence upon the occurrence of the bony deformities has been noted. The inability to support the head, as before expressed, is directly due to this cause. A normal infant should sit up unsupported at 6 months. It

should crawl at 9 months, and should be able to stand by holding to a chair or the sides of its crib by 12 months, and should be able to walk without assistance by 15 or 18 months. These physiologic expressions of development are absent in rickets. Together with other phenomena these findings form valuable diagnostic data. Walking may be delayed until beyond the second and third years. The inability to properly use the legs has given rise to the term *pseudo-rachitic palsy,* which must be distinguished from

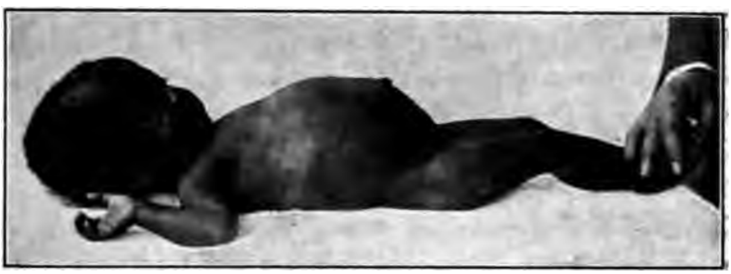


Fig. 40.—Rickets. Pot belly and protruding umbilicus.

paralysis the result of lesions of the nervous system, especially *poliomyelitis.* This distinction is largely made by the presence of other rachitic features and normal knee-jerks. The small, underdeveloped, flabby, hypotonic limbs (Fig. 34) may readily suggest atrophy to the unwary, but the fact that the condition is always bilateral and symmetrical is against poliomyelitis. It must, however, be remembered that rickety infants, as well as others, may suffer from this disease and that paraplegia may be, though rarely, the type of paralysis present.

This muscular hypotonia involves the muscles of the abdominal wall and the involuntary musculature of the intestines as well, and is directly responsible for the promi-

nent belly which is so characteristic of this disease (Figs. 34, 38, 39, and 40). At least in part, it is responsible for the constipation as well. The latter in turn causes the formation of gases which assist in increasing the abdominal distention. This phenomenon (meteorism) I believe to be an important factor in the grave prognosis afforded to cases of pneumonia occurring in children with rickets.

### DENTITION.

The importance of the irregularities of dentition in the early diagnosis of rickets has been described. The second dentition likewise partakes in this irregularity. The first teeth may fall out as soon almost as they appear, leaving the infant toothless until the second dentition takes place. This seriously interferes with the proper development of the jaw, which, already narrowed by the arching of the hard palate, causes the second teeth to be crowded. This results in overlapping from which directly ensue erosions and caries, together with dwarfed and ridged teeth. This is not true in all cases, as it must be emphasized that the fine teeth of many of the African race appear to present a noteworthy contradiction to this statement. However, it may be a fact that the disease in different races may act differently, for carious and eroded teeth appear commonly in rachitic white children. The teeth may be notched or sawlike. In the first instance they must be distinguished from Hutchinson's teeth, which involve, as a rule, the two upper central incisors, and which, in my experience at least, are very rare. I have met this deformity but two or three times in the past 14 years, although I have seen many children suffering from all varieties of luetic disease.

## NERVOUS SYSTEM.

An unstable nervous system constitutes a part of the general makeup of rachitic infants and children. Just why this is so, is not clear. It may be, in the light of quite recent investigations, with reference to spasmophilia, that the calcium balance is disturbed as the result of perverted function or disease of the parathyroid glands, or both. Whether rickets and spasmophilia have a uniform basis is by no means clear. Certain it is, however, that an increased excitability of nervous tissue is more commonly met in the artificially fed, and therefore in rachitic infants more than in others. The response to the galvanic current is more rapid and certain and requires distinctly less current (spasmophilia) in rachitic children. Tetany, convulsions, laryngospasm (laryngismus stridulus), spasmus nutans, all represent evidences of increased nervous excitability and seldom occur in non-rachitic subjects. Intestinal toxemia and constipation, themselves due to rickets, may be the basic etiologic influences for many of these symptoms, which disappear or are decidedly benefited by a proper appreciation of the situation, careful intestinal cleansing and an intelligent adjustment of the diet.

**Blood.**—Aside from secondary anemia, a decrease in the hemoglobin, which does not appear in all cases, the blood of rickets presents nothing of interest which is characteristic.

**Urine.**—No distinctive changes in the urine are noted. The significance of the ammoniacal urine of early infancy has been elsewhere detailed (Chapter II, page 112,—Fat Intolerance).

**DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.**

This disease is distinguished from all others by the *osseous changes*. The early recognition of rickets, before these changes occur or just at their beginning, has been described. A history of artificial feeding in the vast majority of cases, headsweating, craniotabes, late closure of the anterior fontanelle, irregularities of dentition, muscular weakness, enlarged abdomen, late walking, constipation, rachitic rosary, epiphyseal enlargements, curvatures of the spine and of the long bones, constitute the features essential for diagnosis.

It seems very unlikely that one should err by confusing this disease with another, and yet, before the description of it by Sir Thomas Barlow, *scurvy* was at first regarded as *acute rickets* and frequently confounded with it. The individual characteristics of the two diseases are so palpably and visibly different that their recognition should be accomplished without difficulty even when they appear, as they sometimes do, simultaneously in the same subject. The pain and tenderness experienced by infants with scurvy, when handled or moved, is never so severe in rickets as to cause the patient to lie immobile for hours in one position in bed. Bleeding from the mucous surfaces, spongy purple gums, subperiosteal hematoma, anemia and purpura (hemorrhagic tendency) belong to scurvy and do not occur in rickets (Chapter VI, page 223).

The craniotabes of rickets must be differentiated from a similar condition due to *syphilis*. Clinically this is made possible by a history of repeated miscarriages, by the presence of copper-colored skin lesions, mucous patches, desquamative lesions of the palms and soles, wasting, and by

the possible incidence of bone involvement or deep ulcerations. Serologically, the Wassermann reaction offers invaluable confirmatory evidence. The same clinical data are of assistance in differentiating the eroded second teeth of rickets from those of syphilis. The characteristics of Hutchinson's teeth have been described. It must be remembered that the two diseases may appear, especially in negroes, in the same individual.

From *tuberculosis* of the bones it is not always so easy to distinguish this disease. A careful history is important. The presence of ulcerations, pulmonary lesions, and the positive results obtained from the von Pirquet and the Moro test may assist in solving the problem. It may not, however, always be thus easily accomplished on account of the frequent association of these two diseases in the same individual. The digestive disturbances and constipation peculiar to rickety children may be associated with irregular rises in temperature and emaciation. This causes added confusion in eliminating obscure tuberculosis, and should always be borne in mind. From tuberculosis of the spine (Pott's disease) the distinction has already been made (Chapter V, page 200).

The head of rickets must be differentiated from the enlargement due to *hydrocephalus*. In the latter the characteristic squareness is lacking in the outline of the head. The sides are flanged outward and upward from a comparatively small and pointed forehead, causing the formation of a vast expanse of vault consisting of thinned-out bone. The anterior fontanelle is not only opened but bulges, and the sutures are patent, while the marked disproportion between the size of the head and that of the face, which is small, is evident at a glance. The superficial veins

about the lateral aspects of the forehead (temples) are very prominent.

Fig. 41.—Double congenital dislocation of hip, to be distinguished from rachitic lordosis or anterior curvature of the spine.

The points of difference between *poliomyelitis* and the pseudo-palsies of rickets have been detailed (Chapter V, p. 207). *Amaurotic idiocy* is also characterized by muscular weakness. This disease is almost exclusively confined to Russian Jews. It may present a history of heredity. Eye symptoms develop. The characteristic cherry-red spot (Hey Tyne) is seen by the ophthalmoscope upon the macula lutea. Blindness and convulsions supervene, and death is the inevitable and humane result.

Cases in which intense anterior curvature of the lower spine (lordosis) causes the hips to become prominent and misplaced backward and upward, and especially when associated with symmetrical bowing of both femurs, and in which the lower portions of the body appear shortened and likewise where the gait is somewhat waddling, often give the im-

pression of *double congenital dislocation of the hips* (Fig. 41). A careful examination will reveal that motion is not limited in any direction, and that the heads of the bones are properly placed. An X-ray examination affords absolute data.

## COMPLICATIONS.

Digestive disturbances have been mentioned. The liability to convulsions and to other spasmodic diseases, laryngospasm, tetany, carpopedal spasm, spasmus nutans, nystagmus, infantile convulsions, has been discussed as well as the predisposition to tuberculosis and the association of scurvy with this disease in the same individual. The difficulties attending the eruption of the milk teeth in rachitic subjects need no further emphasis. Infants and children with rickets suffer from exudative phenomena—eczemas, intertrigo—and are particularly prone to bronchitis, which has a tendency to become chronic and extensive, and to broncho- and lobar pneumonia. The severity of all infections is intensified when occurring in these patients, and the prognosis is always adversely influenced. Bony deformity, especially that involving the pelvis, may be permanent and seriously affect maternal and infantile morbidity and mortality on account of the subsequent dystocia.

## PROGNOSIS.

Complete recovery from rickets is possible and common. The liability of the disease to be spontaneously arrested is frequently emphasized, especially when the infant reaches that period where it receives food other than cows' milk alone. The disease itself is rarely fatal, its lethal influence being exerted upon those conditions dangerous in themselves and already mentioned as occurring as complications.

## TREATMENT.

**Prophylaxis.**—This is best afforded by breast feeding. Either the milk of the mother or that of a wet-nurse, if feasible, should be supplied. Breast feeding, however, should not be continued beyond the first year. In fact if the infant has cut several teeth and the season of the year is not warm, recourse may be had to solid or semisolid food at 9 or 10 months, and in some instances earlier. I believe it to be advisable to offer such foods as well-cooked cereals, especially oatmeal, rice, barley, meat-juice, fruit-juices, eggs, and broth made from vegetables (Chapter III, page 146) at this period of the breast feeding. These substances should be given in small amounts and should be simply, but well, cooked, and exhibited mashed. The broth made from vegetables, slightly salted, may be given ad libitum as a drink instead of water. It supplies mineral substances, is antacid and laxative.

The greatest difficulty arises in preventing the occurrence of rachitic symptoms in infants who are artificially fed. Much may however be accomplished if the case be watched and if simple though effective measures be conscientiously pursued. Infants require fat and they also require protein in sufficient amount, if rickets is to be forestalled, and yet both these substances may be productive of serious digestive disturbance. This view, with reference to the indigestibility of protein, does not receive support from the present-day teaching of the German school of pediatrists represented by Finkelstein and his confrères. Reference has already been made to this (Chapter II, page 104). Many American pediatrists have been profoundly influenced by the German idea. I wish to repeat that my own view, based upon considerable clinical experience, does not per-

mit me to subscribe to the dictum that cow-protein (*unchanged mechanically or chemically*) may be administered in incalculable quantities without harm. I believe therefore, and have been able to prove, at least to my own satisfaction, that it is important to commence artificial nourishment with small amounts of protein. This cannot however be continued too long, else rickets will occur. The amount must be slowly but persistently increased, and as soon as the signs of protein intolerance manifest themselves measures must be taken, if not to reduce the amount (and this I do not advise at once), to modify it either mechanically or chemically. The methods for doing this have been discussed under the dietetic treatment of protein intolerance and under Marasmus (Chapters II and IV, pages 106 and 172).

The same ideas apply to fat. Fat is necessary and must be fed in sufficient amounts, and as soon as the evidences of intolerance appear, it too must be modified chemically (Chapters II and IV, pages 110 and 179). It may not be amiss to repeat, for the sake of emphasis, that cow-fat differs from the fat of human milk, and therefore 4 per cent. should never be exceeded, and that, as a matter of routine policy, it is safer to feed less than this amount. Where cow-fat cannot be tolerated at all, small doses of olive oil may be given on an empty stomach without gastric disturbance and with considerable benefit in many cases. The same is true, though to a less degree, of codliver oil, which may be advantageously employed as well, by inunction.

While sugar is necessary to produce heat and to conserve protein, and while it is, in my experience, usually well tolerated, care should be exercised not to feed it in

excessive amounts to the neglect of protein and fat. It makes fat babies, but weak and rickety ones. This is the reason why condensed milk continuously used as a routine food must be condemned. It is satisfactory as a go-between, as a substitute for a brief period, but not longer without additional aliment. From 6 to 7 per cent. of sugar should never be exceeded. My routine preference is cane-sugar, for reasons already stated.

Inasmuch as they contain mineral substances and protein as well as starch, which, like sugar, conserves protein, I believe that cereal-waters for general use serve better as milk diluents than plain water. This preference refers especially to oatmeal and barley-water.

All infants artificially fed should receive meat-juice early, and fruit-juices as well, on account of their mineral content and also because they are antacid, stimulating to the alimentary mucosa, and because they are quickly digested and absorbed. For this purpose beef-blood expressed from fresh meat is administered in quantities of from ½ to 2 drams three times a day, exactly one-half hour before feeding, and the vegetable broth above referred to should be given freely (Chapters III and IV, pages 144 and 176).

Lime-water is of questionable service. It probably renders no assistance in the conservation of lime-salts in the economy. It may disturb digestion or produce constipation. In some instances, however, where these effects are not noted, it may be added in the amounts of from 5 to 10 per cent. of the formula as part of the diluent. It is my belief that pasteurization or sterilization of milk (the latter should not be administered too long on account of the possibility of scurvy) is not productive of rickets. However,

unheated, strictly fresh, certified milk is preferable, if obtainable.

By the time an infant reaches 9 months or a year, it should receive undiluted cows' milk. The same additions to the diet, as mentioned above under Breast Feeding, should be given to babies who are being artificially reared, as soon as they erupt several teeth.

Sunshine, fresh air, proper breathing space, good sleeping quarters, and warm clothing are essentials in the prevention of rickets. They are, unfortunately, not always obtainable by those who need them most. Infants, especially feeding cases, should not be kept in hospitals for any great length of time. They do badly as a rule, and frequently develop malnutrition and rickets.

To summarize, it may be stated that the prophylaxis against rickets consists in *breast milk, properly adapted cows' milk containing a sufficiency of fat and protein in digestible form, a proper amount of sugar, cereal-waters, meat-juices, fruit-juices, vegetable broths, the early use of solid and semisolid food, and a wholesome environment which secures to the infant the common-sense requirements of a normal existence.*

**Dietetic Management Beyond the First Year.**—Besides good milk, the main reliance should be placed upon a vegetable diet rich in salts, iron, and lime. Spinach is an unusually serviceable substance. The method of its preparation is discussed under Chapter III, page 147. Mashed skinned peas, mashed skinned lima beans, tender string beans, carrots, stewed celery, stewed or raw onions, mashed baked potatoes, are also valuable. Eggs, soft-boiled or poached, form a splendid addition on account of their high fat and protein content, and also because they contain

phosphorus. Broths and soup and broiled scraped beef should be added as speedily as possible. All foods should be simply, but well, prepared, and fed in amounts that will not overburden the digestion. Should trouble arise, no hesitancy should prevent a speedy recourse to the artificial digestants, pancreatin, taka-diastase, and pepsin.

**Medicinal Treatment.**—There is no doubt that phosphorus administered in suitable form exerts a valuable curative influence, not only upon the pathologic processes which involve the bone, but upon the irritated nervous system as well. It appears, from recent experiments, to increase calcium retention. It may be given alone or in combination with olive oil or, preferably, codliver oil. My experience verifies the statement of Holt, that a vegetable fat such as olive oil is often better borne than an animal fat. Especially is this true if the olive oil be mixed with a small amount of grape-juice. Codliver oil itself is a valuable agent on account of its alterative qualities, the result of the iron which it contains, and because of its direct food value. It supplies fat in a suitable form without, as a rule, producing gastric disturbance. As previously stated, it may be employed by inunction. A combination of phosphorus and codliver oil is represented by the classical prescription of Kassowitz:—

| | |
|---|---|
| ℞ Phosphorus | 1 part. |
| Codliver oil | 1000 parts. |

Sig.: f℥j *t. i. d.* one-half hour after food.

Jacobi years ago recommended phosphorus as a valuable therapeutic agent in the treatment of rickets. The usual dose for an infant under 1 year is $^1/_{300}$ grain three times a day.

The preparations of calcium—calcium lactate gr. iij to gr. x, t. i. d., or the syrup of lactated calcium, f℥j, t. i. d., or calcium in combination with phosphorus, as found in the syrup of hypophosphites compound of the U. S. P.—are of service too. Their direct effect in staying the rachitic processes has not been fully demonstrated, but they unquestionably, especially in the light of modern investigation, exert a soothing influence upon nervous tissue and tend to prevent the occurrence of periodic or permanent nervous phenomena.

When nervous excitability does not appear as a prominent feature and where muscle weakness is unusually prominent, I have come to regard strychnine in the form of the sulphate gr. $^{1}/_{200}$ to gr. $^{1}/_{100}$ t. i. d. as a beneficent tonic when continued over a considerable period of time. Such alteratives and tonics as the syrup of the iodid of iron ♏v-x t. i. d. and the syrup of hydriodic acid ♏x-xv, alone or together, or both combined with the simple or the compound syrup of hypophosphites, find a valuable field of service in the presence of anemia, chronic bronchitis, or glandular enlargements. These agents may be constipating or may interfere with digestion. For this reason care must be exercised in their administration. The combination of a simple tonic laxative, as the aromatic fluidextract of cascara sagrada, may render valuable assistance.

My assistants in my clinic at the Mt. Sinai Hospital in Philadelphia (Drs. J. L. Werner and I. Rubin) have under similar conditions obtained excellent results by administering the following by hypodermic injection three times a week, especially where the anemia is associated with much splenic enlargement:—

| | |
|---|---|
| ℞ Ferri citratis viridis | gr. 8/10 |
| Sodii cacodylatis | gr. ½ |
| Sodii glycerophosphat. | gr. 1½ |
| Aquæ destill. (sterile) | ♏xx |

M. et ft. ampulla no. j.

Digestive disturbances are met as they arise, on general lines. An occasional intestinal cleansing with castor oil is serviceable. For the persistent constipation small doses of gray powder gr. ½ t. i. d. or oil enemas three times a week, abdominal massage or Philip's milk of magnesia ♏x-xl to every or to every other bottle, according to effect, or some palatable preparation of cascara ♏x-xxx once or thrice a day are serviceable. Of late I have been impressed with the value of some of the newer preparations of liquid paraffin (Chapter VIII).

**Non-medicinal Treatment.**—Frequent cleansing of the skin surface is useful, especially when followed by thorough rubbing. It not only improves the circulation of the skin, but causes deeper and fuller respirations, and therefore assists in maintaining the symmetry of the chest.

The first teeth of the rickety child should receive dental care. All cavities should be filled with cheap material and all hopelessly decayed teeth should be extracted. The mouth should be kept in as aseptic condition as possible. In this way alone may obscure toxemias, digestive derangements, and skin rashes be avoided. This applies to other diseases as well as to rickets.

Much may be done by way of prophylaxis to prevent the occurrence of severe deformities by making an early diagnosis of the disease. Rickety children should not be made to stand before they are able or before they do so voluntarily. After they do commence to stand the individual should be studied, and if his legs appear unusually

small and weak, he should not be encouraged to bear his weight upon them. Braces should not be applied until the child walks, but should then be provided early and be worn continually, either to prevent the occurrence of deformity or to secure its early correction. A discussion of the types of braces or of the various orthopedic maneuvers employed for the correction of the osseous deformities, temporary or permanent, are beyond the scope of this volume and cannot be treated in detail.

# CHAPTER VI.

## SCURVY.

**Definition.**— Scurvy is a disease of metabolism depending upon an as yet unknown etiologic factor. It is consistently associated with artificial feeding. The diet is commonly lacking in raw animal and vegetable products. It is characterized by a premonitory period of peevishness and irritability, which is later followed by hyperesthesia and actual pain and tenderness in the bone. Hematuria and subperiosteal, gingival, and visceral hemorrhages complete the clinical picture.

### ETIOLOGY.

The actual determining cause is unknown. The disease is probably non-infectious, although the subnutritional state predisposes to secondary infection. Metabolic disarrangement is probably responsible for the presence in the blood of some as yet undetermined chemical compound or compounds from the effects of which the symptoms arise. The disease occurs with the greatest rarity, if at all, in the breast-fed and only in those cases in which maternal nursing has been continued over too long a time (15 or 16 months).

Children fed for a long period upon the patented foods, which are made with or without milk, appear to suffer most. Plain boiled milk, contrary to the usual teaching, does not, if the boiling be but momentary, appear often to produce scurvy—at least, in my experience. *Prolonged boiling,* on the other hand, with the addition of a patent food, determines most cases. It is uncommon under 3 months. Most cases appear after 6 months. It is rare after 18 months.

## PATHOLOGY.

The characteristic lesion of the disease is distinguished by ***hemorrhage under the periosteum*** of the long bones and by ***hemorrhagic infiltration*** of the internal organs. These extravasations of blood are large or small, and may be microscopic. Bone changes also occur, but are less marked than in rickets. *Epiphyseal separations* are common. The extravasated blood undergoes absorption and organization, leaving behind hard, thickened areas.

## CLINICAL HISTORY AND SYMPTOMATOLOGY.

The infant has never received breast milk or, if it has, it has been, as a rule, discontinued early and usually for an insufficient reason. On the other hand, a history of prolonged exclusive breast feeding may be, in very rare instances, obtained. Personally I have never met a case. It has been placed upon an indifferently modified cows' milk, alone or in combination with a patent food. Frequently, a history consisting of the exclusive feeding of condensed milk is given. In most instances the food has been subjected to *prolonged boiling,* although this is not constant. The infant has never received, or at least has received very irregularly, *animal* or *vegetable juices.* The baby may or may not have been placed upon the artificial food on account of a digestive upset while on the breast (very common reason), or there may be a digestive upset after being placed upon the modified milk. For this reason one patented food after another has been tried. The distinguishing point to remember is that the food *lacked freshness,* or perhaps, what is a somewhat poor but more expressive statement, it lacked *the vital principle of rawness.*

The sweet-dispositioned baby which has been growing fat, now becomes *irritable* and *peevish.* It *cries* and *whimpers* when it is *approached, and especially when picked up or while being bathed. If it has walked, it now refuses to do so, or it will not stand, crying when placed upon its feet.* This occurring in a previously healthy infant of 11 or more months of age is so characteristic of this disease that it assumes almost pathognomonic importance. *A pallor of the skin* is noted and *the child is content to lie* in its crib *undisturbed for days at a time.* This is a very characteristic and early feature. The bowels may be normal, or there may appear evidences of indigestion and the movements may contain visible or occult blood. Melena is rare. Hematuria occurs and may be the only symptom. The amount of blood varies as the intensity of the disease. It may only be detected by the microscope. Albumin and casts are usually present with the blood, but they are not an essential part of the disease and may represent a true complicating nephritis. Pus, from an associated pyelitis or cystitis, has also been found in the urine.

A characteristic symptom of the disease is *subperiosteal hemorrhage.* It may be the first intimation of the real nature of the child's indisposition. The previous ill-health described has been present, but an incorrect interpretation has been placed upon it, the most likely diagnosis to have been made being rheumatism. In the history it is so commonly stated by the mother that her infant has been treated for rheumatism that suspicion of scurvy should be aroused by this fact alone. The hemorrhages occur usually under the periosteum of the long bones, most often the femur and tibia—the lower extremities being affected with greater frequency than the upper. The subperiosteal extravasations

PLATE XII

The appearance of the gums in a case of infantile scurvy. Note swollen condition and purplish discoloration, especially around the bases of the erupted teeth. This condition is pathognomonic of the disease.

of blood cause swellings, which appear with more or less suddenness. The swelling is large or small, as the case may be; is more or less pyramidal in shape, occupying usually the lower third of the bone near the joint, but not involving it; is of a doughy feel, and may give the sensation of fluid under tension, distinct fluctuation being rarely experienced (Fig. 42). Fig. 43 represents the same case cured, but still showing evidences of rickets. The superficial veins over the swelling may be prominent and the extremity below is often edematous. The *edema* may, however, be present in both feet, being independent of the pressure exerted by the extravasated blood.

These hemorrhages may occur in any part of the body, either into the viscera, the walls of the intestine, the meninges, or into the cavity of the orbit. The last causes sudden and, for a time, unexplainable unilateral, rarely bilateral, *exophthalmos*. The blood may find its way into the eyelids or conjunctiva, giving the appearance of the so-called black eye which is erroneously thought to be due to trauma. The extravasated blood causes pain by pressure. As a result the infant lies in a more or less characteristic attitude. The thighs are usually abducted and rotated outward. *Epiphyseal* separation may occur as a result of the large extravasations of blood. This condition may be erroneously diagnosed epiphysitis, the underlying scurvy being entirely ignored. In fact all real instances of apparently primary or spontaneous epiphysitis should be regarded as scorbutic until it is conclusively proven that they are not. Aside from the hemorrhagic symptoms which are, in themselves, convincing, the X-ray provides a very easy and valuable means of distinguishing an epiphyseal separation due to hemorrhage, from an acute epiphysitis. Likewise in

the latter the differential leucocyte count would indicate an increase in the polymorphonuclear cells.

The mouth appearance is characteristic. The gums, especially, if the teeth are not present, may appear normal. On the other hand, they may be *spongy and red,* bleeding with great ease. Most distinctive is the picture if the teeth have been erupted. *Around the base of each tooth,* or *perhaps covering the whole cusp, except the cutting edge, the gums are purplish, red, and swollen* (Plate XII). The rest of the gum may appear normal or, as the result of secondary infection, gingival ulceration has been noted. Extravasated blood into the mucous membrane of the hard palate may appear as a more or less circumscribed, bluish swelling.

Hemorrhages into the viscera, as the liver or spleen, or into the walls of the intestines (Still) occur, but are very difficult to recognize when present alone. The *blood* shows nothing typical other than the evidences of *symptomatic anemia, slow clotting,* and *leucocytosis* as *the result of the hemorrhages.* The hemoglobin averages about 45 per cent., but may go lower, and the red cells number about 2,500,000 or less. *Care should be taken not to regard the presence of leucocytosis as an evidence of inflammatory disease, else the diagnosis may be clouded.* In this connection the *differential count will reveal the absence of an increase in the polymorphonuclear cells* when the leucocytic excess is not dependent upon a primary or secondary infectious process. *Purpuric eruptions* occur, but are neither constant nor as common as usually supposed. The single lesions may present the appearance of a traumatic ecchymosis, and in fact may be directly dependent upon slight trauma inflicted simply by handling the child. The de-

pendent portions of the body are more commonly involved. *Epistaxis,* while rare, has been noted. The *temperature* of scurvy cases, while often normal, is just as frequently elevated to 101° F. or 102° F. The fever is most likely

Fig. 42.—Scurvy. Subperiosteal hematoma of right thigh, edema of legs and left thigh.

dependent upon the absorption of aseptic blood-clot and fibrin. Hyperpyrexia is rare and is usually dependent upon secondary infection of the blood-clot, or is due to pyelitis or cystitis.

**DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.**

The case represented by Fig. 42 was submitted to the staff connected with a large children's clinic, for an opinion. Each physician was permitted to separately elicit the history and to examine the patient. The following diagnoses were received: *sarcoma, rheumatism, osteomyelitis, periostitis, tuberculosis, rickets,* and *ununited fracture. Sarcoma* may be eliminated by the previous history, the comparatively sudden appearance of the tumor, the condition of the gums, other evidences of hemorrhagic extravasation, and the rapid recovery upon the institution of proper dietetic management. *Rheumatism* is distinguished by polyarticular involvement, acid sweats, characteristic temperature, and its comparative rarity during infancy. The joints in scurvy are rarely involved. This is the most common mistake in reference to the diagnosis of scurvy. It is so common that it is of sufficient importance to repeat that the very fact of making a diagnosis of rheumatism in an infant is in itself sufficient evidence to arouse suspicion of the presence of scurvy. *Osteomyelitis* and *periostitis* may cause some confusion. They more commonly attack the tibia. There may be a history of trauma. There is an absence of hemorrhages. The temperature is decidedly septic and the skin over the bone is reddened and inflamed. Leucocytosis is usually over 20,000 and is distinguished by an increase in the polymorphonuclear cells. *Tuberculosis* may be excluded by the history, the longer duration of the case, the presence of tuberculosis elsewhere in the body, the absence of hemorrhages, and a positive Moro or von Pirquet reaction. *Rickets* may accompany scurvy as in the case here illustrated. Pure rickets, however, presents a different history and is unassociated with a hemorrhagic

tendency. In rickets the bony enlargements affect the epiphysis and are distinctly localized. The other bone changes usually take the form of curvatures and are brought

Fig. 43.—Same child after recovery from scurvy. Note absence of swelling of extremities. Child still undernourished; still shows some evidence of rickets (square head, beaded ribs, relaxed belly). Expression, however, is natural.

about by the action of gravity and muscular traction and atmospheric pressure. *Ununited fracture* usually gives a history of trauma and, while some resemblance between it

and scurvy may exist, the mistake should not occur if the latter be borne in mind. The distinguishing features of epiphysitis have been indicated, except that epiphysitis most often involves the lower forearm. Of especial importance is the history of a perverted dietary and the early development of anemia, peevishness, crying when handled or bathed, and a very evident desire to lie in bed undisturbed.

## PROGNOSIS AND COMPLICATIONS.

When detected sufficiently early, before the infant's strength is exhausted, the outlook is good. Recovery is prompt and permanent. A marked change is noted usually in four or five days, although cases which are recognized late may extend over four or five weeks. If the case has progressed too far, death from asthenia occurs. Cerebral and visceral hemorrhages, secondary infection, epiphyseal separation, occur in neglected cases. Those cases which present a delicate digestive apparatus or food idiosyncrasies or are complicated by severe rickets, end slowly in recovery, or may terminate fatally.

## TREATMENT.

This is purely dietetic.

**Prophylaxis.**—Breast feeding up to 9 months or a year and not longer. If the child is artificially reared, prolonged boiling of the food is not permissible without the addition of other food. Fresh fruit-juices,—orange, plum, grape,—as well as fresh beef-juice, are to be fed regularly to the infant between milk feedings. Patented foods, especially those that require boiling, are to be eschewed as a permanent diet.

**Treatment of Attack.**—The best possible hygienic surroundings should be secured. In the beginning the infant should not be unduly disturbed by too frequent attempts to bathe it or to change its clothes. Scorbutic swellings, no matter how much they may resemble inflammatory exudates, are under no circumstances to be incised. Such a procedure may cause fatal hemorrhage or secondary infection. Where it is impossible for the mother to suckle her babe, wet-nursing, if feasible, should be secured. In the absence of either of these sources of food, *raw* cows' milk adapted to the child's age and digestive capacity, is the remedy that will bring about a cure. *Fruit-juices*—preferably *orange-juice* from 2 to 3 ounces a day—must be administered, but not just before or after a milk feeding. If necessary it may be sweetened, or if not available the juice of apples, plums, or grapes may be substituted, although orange-juice is preferable. From one-half to one whole, mealy, *baked* or *boiled potato,* given plain or creamed with milk, possesses an excellent antiscorbutic effect. Fresh beef-juice (not beef-tea or beef-extracts), fluidounce ½ to fluidounce 1, a day, must also be given. Gelatin may also be of some assistance.

There is no special medicinal treatment, except the use of tonics to combat the anemia. The hypodermic administration of the citrate of iron alone, or with sodium cacodylate, admirably fulfills this indication.

# CHAPTER VII.

## VOMITING.

THIS condition is not a distinct disease entity. On the contrary, my main purpose shall be to emphasize its importance as a symptom. Regarded as such, it becomes necessary to study in detail the etiologic factors concerned, so that an intelligent therapy may be arranged. It follows therefore, too, that each case must be individually considered. The causes of vomiting differ somewhat in infancy, *i.e.*, under 2 years, from those occurring in early childhood (after 2 years); hence a more or less elastic subdivision may be formed as follows: *No. 1, Vomiting of Infancy; No. 2, Vomiting of Early Childhood.*

### VOMITING OF INFANCY.

In the early days of life, up to the age of 6 months the stomach is almost entirely covered by the large left lobe of the liver. When the stomach is filled the liver, therefore, interferes with the rapid emptying of the gastric contents through the pylorus and, by pressure, causes the stomach to assume a more vertical position than when empty. This, together with the undeveloped valve action of the cardiac end, permits and explains the *early regurgitation* of food at this time of life. This type of vomiting or, better called, regurgitation, occurring immediately after feeding, may be regarded almost as physiologic, or simply as the overflowing of an overfilled reservoir. In some cases it does no harm. In others, should it become excessive, it decidedly interferes with the nutrition

of the infant. It becomes less frequent after 6 months, as there is, after this period, a decided increase in the greater curvature and the cardia, together with the development of the valve-like action at the cardiac orifice. Nor does the liver cover the entire organ.

The prevention and cure of this variety of vomiting can often be readily accomplished by the forming of regular habits which permit of a correct feeding interval, and of the administration of the proper amount of food at each feeding. The infant must not be picked up immediately after its meal, and it must be laid upon its right side so that the rapid emptying of the stomach may be favored.

The *pernicious habits of irregular feeding and of over-feeding* are responsible for the vast majority of cases of functional vomiting occurring under 1 year in both the breast- and in the bottle-fed. In making this statement my personal experience is not in accord with certain teachers who advocate the giving of as much food to an infant as it wants, and as often as it wants it. Physicians are led into this error by regarding crying as a sure sign of hunger. They forget that the baby may be thirsty or otherwise uncomfortable.

The giving of food, on account of its warmth or pleasant taste, may momentarily relieve colic or distract the baby's attention and thereby quiet it. The pain returns with increased vigor and is again assuaged in a similar manner. *Simple regurgitation of food now becomes a condition of true vomiting, dependent upon fermentation and dilatation, if not upon actual gastritis.* The best argument that an infant should not be permitted to nurse until it voluntarily stops, is furnished by anatomic and physiologic facts. The capacity of an infant's stomach at birth is,

approximately, an ounce and, according to the figures offered by Cotton, this develops as follows:—

| | |
|---|---|
| End of first month | 2½ oz. |
| End of second month | 3½ oz. |
| End of third month | 4½ oz. |
| End of fourth month | 5 oz. |
| End of fifth month | 5½ oz. |
| End of twelfth month | 8½ oz. |

My own experience, based upon actual weighing experiments, with quite a large number of breast-fed babies, before and immediately after feeding, as to the stomach's ability to hold the amounts at the various ages indicated, would place the figures even somewhat lower. However, taking these as a guide, one cannot help but see how ridiculously foolish it is, not to say dangerous, to offer to an infant under 1 month of age, from 4 to 5 ounces of food at a nursing, as I frequently see done by men of large patronage and experience. This practice is pernicious and, when it induces vomiting, the condition is most difficult to control, even after the quantity is reduced. The reasons for this have been mentioned, namely, dilatation and atony, if not true gastritis. A safe rule, perhaps, would be *to regulate the quantity fed in such a manner that it represents in ounces the child's age in months up to about 6 months. After this the rate of progression should be slower* (Chapter II).

What is true of the quantity fed as a cause for vomiting is likewise true of the *interval of feeding*. No new food must be put into the stomach until the organ has emptied itself, regained its tone, and rested. *Feeding too frequently* is as pernicious as too much food at a feeding, and amounts to the same thing, and is productive of the same ill-effects. It retards gastric digestion, impedes gastric

motility, and hence produces fermentation, colic, vomiting, and other symptoms upon which depend, in turn, the early evidences of malnutrition and essential marasmus. It is a notorious fact, readily confirmed by anyone who has had a large experience in the management of these wasted babies, that the vast majority of them present a history in which overfeeding or too frequent feeding, or both, are the determining etiologic factors. *While what an infant receives as food is important, it is just as important how it gets it and when it gets it.* The caprices of its appetite or the whims of its caretaker are poor judges of what is necessary to supply its nutritional demands.

The prevention and cure of this type of vomiting is self-evident, viz., the proper regulation of the food as to the *quantity* and the *interval* of feeding. The first has already been discussed. As to the second, no fixed rule will apply to each infant. The individual must be studied to learn his peculiarities, but when once the interval has been determined it must be adhered to strictly.

If the infant is not to vomit after feeding, it is not to be picked up or shaken, but after its meal it must be permitted to lie quietly undisturbed, preferably on its *right side*. The time spent at the breast should vary from ten to thirty minutes, dependent upon the age of the infant and the interval of feeding, but under no circumstances should the meal be interrupted to be resumed again later. These rules apply to the bottle-fed, as well as to the breast-fed baby.

The causes of vomiting thus far detailed apply to both classes of infants. There are, however, certain conditions which, while applicable to all infants, apply with more emphasis to the breast- or to the bottle- fed, as the case

might be. Thus we have the importance of the *composition of the food* applying with greater force to the bottle baby, although its significance cannot be ignored entirely when dealing with breast-fed children. The ingredients of the food most commonly at fault are the *fat* and less often the *sugar,* and to those accustomed to dealing with these cases the clinical symptoms are significant and frequently permit of a correct interpretation (Chapters II and IV).

The vomitus due to excessive fat is distinctly sour and acid, smelling like rancid butter. It contains lumps of coagulated calcium casein, holding within their meshes the fermenting fat which is soluble in ether and reacts characteristically with osmic acid, and to Sudan III. These pieces of curd are large or small and have a yellowish appearance. The time of vomiting in this condition is important, *occurring from one hour to one and a half hours after feeding,* i.e., *after fermentation has occurred.* The vomiting due to *excessive feeding* or to too frequent feeding, on the other hand, *occurs immediately* after a meal, the vomited matter being as a rule, in the beginning, unchanged and frequently uncoagulated. With vomiting due to fat intolerance there are characteristic bowel symptoms as well which have been discussed in Chapters II and IV, pages 111 and 179.

The remedy, if in the breast-fed, is to attempt the reduction of the fat percentage by modifying the mother's milk. This is, as a rule, more readily accomplished than to increase the percentage where the fat is too low. The free drinking of water by the mother, the partial or complete exclusion of milk, soup, malt liquors and meat from the dietary, increase in exercise, and the occasional use of laxatives are measures well calculated to accomplish the result desired. In rare instances the infant's stomach should be

washed once or twice. This applies with greater force to the bottle-fed. Each nursing should be preceded by an ounce or two of some cereal-water, preferably made from barley or wheat. Occasionally these cases progress more rapidly if the meal is followed by a grain or two of extract of pancreatin, used simply as a temporary means until the fat reduction is accomplished. Where it is impossible to reduce the fat the breast milk may be withdrawn and diluted with a cereal-water and fed from a bottle, or the first milk may be expressed or pumped from the breast, and the infant allowed to suck "middle" milk or "last" milk so called. Very rarely the breast milk may be withdrawn and pancreatized. Any of these maneuvers, alone or in combination, will usually suffice to accomplish the desired result in breast-fed babies.

In bottle babies, as a rule, the problem is simpler. Here, following the stomach washing, the infant is fed for twenty-four hours upon some cereal-water or weak tea slightly sweetened with sugar or with saccharin (gr. j to a quart). The physician may then, by increasing the dilution of whole milk, so adjust the fat content as to suit the infant's digestive capacity. This failing, resort may be had to pancreatization or to the temporary feeding of whey, which is weak in fat. In rare instances, where vomiting continues and the infant appears to be intolerant of all fat, we may employ, with success, modifications of skimmed milk, eiweissmilch, buttermilk, or condensed milk.

Sugar is rarely a cause of vomiting, but may be. It practically never is in the breast-fed. When a source of trouble, it is not uncommonly associated with a watery diarrhea. The vomitus is watery, sour, and hot, and occurs late after feeding and may cause crying, as the regurgitated

material may produce a burning pain in the esophagus. The remedies consist of an initial purge, rarely a stomach washing, less often a colonic flushing, and the reduction in the amount of sugar. Buttermilk and eiweissmilch, which are sugar-poor, may be of service.

The protein rarely causes vomiting, unless given in excessively large amounts, when the resulting curd acts as a foreign body and is expelled. Sodium citrate added to the formula in the strength of 1 to 2 grains for every ounce of milk and cream in the mixture has, in my experience, been of considerable aid in overcoming vomiting due to tough curd formation in the stomach.

As a cause for vomiting *congenital pyloric obstruction* is too rarely recognized. I have elsewhere called attention to this fact, but wish here to offer what follows, as a safe guide, with the hope that others will adopt it as a means for diagnosis and for saving the lives of many infants whose condition becomes hopeless before it is recognized, and whose deaths are largely ascribed to other causes, viz., *that all cases of vomiting, beginning at birth or shortly thereafter and continuing in spite of a reasonable amount of food manipulation, especially in breast-fed infants, or in artificially fed ones as well, are to be regarded as cases of pyloric obstruction, until it can be proved that they are not.*

In direct opposition to this fatal type of persistent vomiting should be mentioned a type of persistent vomiting or spitting up, of an entirely *benign* nature. This occurs in either perfectly healthy breast or bottle babies who persistently and steadily continue to thrive and to gain in weight. An adequate explanation for its occurrence is difficult or almost impossible of determination, and no treatment seems to be of avail. Dietetic manipulations are

without effect and usually do harm by interfering with the infant's nutrition. The weight either remains stationary or a slight loss is recorded. It continues until it is spontaneously arrested as stated, and not infrequently occurs in perfectly healthy breast babies, where the breast milk, by repeated analysis, is found to be perfectly normal. While a cause for it undoubtedly exists, the most plausible explanation is a vicious habit, which, perhaps, has its origin in faulty hygiene. The condition may be cautiously diagnosed and a good prognosis given only when all other possible causes have been entirely excluded.

A type of vomiting closely akin to this is that due directly to *nervous irritability* or *nerve exhaustion* or even, perhaps, to a *nervous habit* or *tic* affecting the gastric musculature. While the exact nature of the mechanism of the nervous involvement is not easy of detection, clinical experience and close observation will sooner or later unmask the true nature of the condition as to its nervous origin. These babies fuss while nursing the breast or sucking the bottle—or if this does not occur, as soon as the feeding is finished, they begin to fret or to squirm and wriggle and distort their features until vomiting occurs, either forcefully or not so. The vomiting may be preceded by chewing motions. The nutrition does not always suffer seriously unless the food is changed too often, especially as is commonly the case if the food be weakened too much. The reason why they maintain a stationary weight or lose but slowly is because many of these babies will nurse well at night and retain their nourishment. This is an important point in making the diagnosis, but is often not elicited except by accident or only after careful inquiry. I have met many such cases after they have gone the rounds of

many physicians and have run the gamut of an innumerable variety of milk formulas and patented foods. These infants resemble the adult neurasthenic whose distressing symptoms are commonly relieved after sunset—a strong point always in the diagnosis of nerve exhaustion. Some of these babies will only nurse well and retain their nutriment if it is given to them during sleep, they positively refusing to take it while awake, immediately rejecting that which was forced upon them.

The diagnosis of nervous vomiting must, especially in infants, be made with extreme caution and only after all other possible factors have been eliminated. In considering the treatment of these babies the most important thing to learn not to do is to change the food too often. Once the diagnosis is made, the vomiting must be ignored as far as food changes are concerned, provided the stools show the digestion to be normal. One or two stomach washings with soda bicarbonate solution may be of assistance, but must not be continued. Paraf Javal's preparation of strontium bromid ♏v-xv may be administered one-half hour before feeding, four times a day, in a little water. As the age and nutrition demand it, the strength of the food should be slowly increased, in quantity as well as quality. Advantage should be taken of the fact that these babies retain their night feeds well by giving them nourishment throughout the night, at about three- or four- hour intervals.

Vomiting is a symptom of *summer diarrhea*. This is almost entirely confined to the bottle-fed. It is impossible to enter into a discussion of this disease at this time, but I wish merely to refer to the symptomatic and prognostic importance of vomiting. Occurring at the very onset of the disease, it results from the direct irritation of the gastric

mucosa, and is benign in character, in that the system is saved the absorption of a large amount of fermenting material if it were to pass through the gut. Occurring continuously throughout an attack, or manifesting itself as a late feature, it is ominous, resulting from intense toxemia and, in the majority of instances, foreshadows a fatal outcome. Treatment is unsatisfactory. Lavage to be of value must give speedy results, and must not be continued too long or be too frequently repeated. A valuable procedure is gavage. Not infrequently, when the smallest quantities of food are expelled when fed by spoon or bottle, they will be retained if given by the stomach-tube. However, care and skill must be exercised in feeding by this method (Chapter XIII, page 363). The gavage should follow the lavage. The food, on the other hand, may be administered through the nose (Chapter XIII, page 361).

Not infrequently all food by mouth must be suspended and the infant sustained by small nutrient enemata following colonic lavage. If foods are given by the mouth, they must be of the mildest kind and in small bulk, concentrated but non-irritating. Cereal-waters or cereal-gruels, egg-water, condensed milk diluted 8 or 10 times with a cereal-gruel, whey or mutton-broth, are our main reliance. Thirst may be allayed by hypodermocylsis or by the Murphy treatment. I have seen this give brilliant results in desperate cases. Occasionally hot water dropped upon the tongue will stop vomiting. Medicaments are of little value, perhaps the best being a small dose of bromid of strontium gr. j-ij, or the Paraf Javal preparation just mentioned.

Vomiting is often a symptom of *grave abdominal disease*. As a rule it here depends upon peritoneal irritation. *Intussusception* is the most frequent condition met in in-

fancy, while *appendicitis, peritonitis, purulent* and *tubercular,* occur more often in childhood. The character of the vomitus will not infrequently be the concluding point in the symptomatology of intussusception, although I have mistaken a fatal purulent peritonitis occurring in an infant 1 week old, as the result of umbilical-cord infection, for intussusception, on account of constipation and fecal vomiting. I have also seen a small retroperitoneal sarcoma, in an infant 6 days old, produce fecal vomiting and bloody stools. Vomiting under these circumstances has no special treatment, its main importance being diagnostic and its outcome depending entirely on the proper surgical treatment of the case.

An important point to be considered in the etiologic diagnosis of vomiting in infants is the *insidious development of hydrocephalus.* This is mentioned to put the practitioner on his guard, as I have on five or six occasions seen this error made both by myself and others.

### VOMITING IN OLDER CHILDREN.

The more common causes for vomiting in older children are the *acute infectious diseases, pneumonia, dietary indiscretions, with or without acute gastritis, acute indigestion, poisons, acute abdominal disease, uremia, brain disease, acidosis (cyclic vomiting, so called), reflex causes, and ocular conditions.* Vomiting is an important initial symptom of *scarlatina, smallpox, meningitis,* and less so of *measles.* It may replace the chill of *pneumonia.* The direct origin of vomiting in these conditions, with the exception, perhaps, of meningitis, is toxic.

By far the vast majority of cases of vomiting in young children is due to dietary indiscretions. Included within

this term are those cases due to chemical or food (ptomaines) poisons, or medicines ingested by accident or otherwise. These cases may or may not have the added element of gastritis as a causative factor.

The treatment of this class of cases may be embraced within a general plan. The greatest element is prevention. It is a grave mistake not to supervise the food of a young child up to at least 4 or 5 years, and even after this vigilance should not be relaxed. Up to the age of 1 year, in most instances, the infant should receive very litle besides milk, and that preferably maternal. A certain amount of latitude can perhaps be permited in this direction, depending upon the individual. Many physicians are in the habit of permitting a certain variety of dried bread called zweiback, at a very early age. I have never seen any harm therefrom, but in the majority of American children I feel that an exclusive milk diet is best, at least up to 9 or 10 months, or until the infant has cut several teeth. After this the diet should be regulated according to the directions given under Chapter III, page 140.

"Bring up a child in the way it shall go and when it is old it will not depart therefrom" applies to diet as well as to morals, and an adherence to a simple diet of wholesome foods, with absolute regularity, will prevent as many and more cases of vomiting and indigestion as the vicious habit of continuous nibbling and overfeeding of improper foods will produce. Frequently children are brought to the physician by an anxious mother with the tale that they have no appetite. Careful inquiry will invariably elicit the history that the day is occupied by one continuous meal of small quantities of sweets and indigestibles.

The active treatment, after eliminating the cause of this

condition, consists in the administration of an emetic, if too much time has not elapsed since the ingestion of the substance. If the stomach has not been actively irritated or inflamed, lavage should be practised. This is a very difficult procedure in young children and should only be employed if urgent. Following this a purgative, preferably iced castor oil, or if this is not tolerated, calomel, triturated well with sugar of milk, should, in small dose, be placed dry upon the tongue. Food should be omitted for twenty-four hours and, when resumed, should be of the mildest kind and given often, but in small quantities. Ice by mouth and a mustard paste upon the epigastrium may be of service, while, of medicaments, cocaine gr. $^1/_{80}$, bismuth gr. x, and strontium bromide gr. iij are the best.

In acute abdominal disease, especially in appendicitis and in peritonitis, as mentioned before, the interest attached to vomiting is purely academic and diagnostic. In peritonitis the vomitus may become fecal in rare instances and indicates a fatal outcome. Rarely these cases are benefited by extensive lavage.

The insidious onset of nephritis and uremia is often announced by an unexpected attack of nausea and vomiting. This is especially true when occurring during the third or fourth week of an attack of scarlet fever, and such an occurrence should always lead to a urinary analysis. In this disease, therefore, vomiting becomes a symptom of much diagnostic import. Its treatment consists in the treatment of the underlying cause and is entirely eliminative, this being accomplished by diaphoresis, diuresis, and catharsis.

Vomiting when associated with or rather due to brain disease, especially tumor, abscess, meningitis, less often

hydrocephalus, is also of diagnostic importance. It is projectile in character and occurs without nausea. There is no special treatment.

Of greater interest, perhaps, than all these, in that it is peculiarly a condition of childhood, is periodic or so-called *cyclic vomiting*. Children, apparently otherwise well, but of delicate mold, the former subjects of scurvy, marasmus or rickets perhaps, without any apparent cause, certainly without any indiscretion in diet, are seized with severe attacks of vomiting. First the stomach contents are ejected and then, with severe straining and retching, a large quantity of bile-stained material is thrown off. There may or may not be associated fever. Usually, however, the temperature does not go much higher than 100° F. Jaundice does not occur, but the skin becomes muddy. Soon the attack ceases spontaneously and the child is as well as ever and hungry, and remains so until the next attack occurs within a few weeks. Preceding the attacks the child becomes languid, pale, loses interest in its play, and has dark rings under its eyes. By these signs the caretaker can, if observant, foretell an attack by twenty-four hours. These children are usually anemic, have a hemoglobin percentage of below 60, and are sometimes the subjects of purpura. There is usually a slight leucocytosis up to 15,000. The etiology of this interesting condition is obscure, although the researches of Edsall and others would point to an acidosis or an acidemia. Many of these cases present a highly acid urine containing large amounts of acetone, diacetic and oxybutyric acids.

Treatment is unsatisfactory. The attack is self-limited and remedial measures are of no avail. Between attacks all efforts should be directed toward building up the general

strength, improving the nutrition, and overcoming the acidosis. With this end in view the diet should contain starches and only a moderate amount of protein. Digestants should be given if needed, and large doses of sodium bicarbonate over a long period of time are regarded as specific by Edsall and do good in many cases as a preventive. Iron citrate or sodium cacodylate, alone or combined, and administered hypodermically, may be useful in combating anemia.

Reference has elsewhere been made to those cases of periodic vomiting which are not due to acidosis, but which depend upon pylorospasm, which originally developed in infancy and which has not entirely recovered. These cases can be recognized if sought and especially if they are studied by the X-ray (Chapter XII).

# CHAPTER VIII.

## CONSTIPATION.

THIS will be discussed largely from the standpoint of treatment. The term itself is more or less comparative. The movements may be sufficiently frequent but small in bulk. They may be both sufficiently frequent and of normal bulk, but too dry in consistency. When constipation is complete it is said to be obstipation. This usually depends upon an organic basis. An intelligent therapy can only be arranged after considering the etiology in some detail.

### ETIOLOGY.

Two factors are operative more or less in nearly every case of costiveness, viz., *diet* and *habit*. This is true of infants as well as of children. Many babies are made constipated because the caretakers do not give them an opportunity to evacuate their bowels spontaneously. This results in the routine administration of drastic purgatives and local irritants, as suppositories and injections. The bowels shortly cannot empty themselves unless they are so stimulated.

A diet *poor in sugar and fat or one rich in protein* is particularly harmful in this respect. Food which is completely digested also predisposes.

Habit is especially potent in older children. The response to nature's call is delayed, with the result that atony of the bowel and gaseous distention ensue. In cases of rickets in which the involuntary musculature of the small

intestines is decidedly at fault, this state of affairs also exists.

**Constipation in the Breast-fed.**—A great many mothers complain that their babies are constipated. I find in most instances that these women do not give their children a chance to move their bowels naturally. They proceed to administer purgatives and injections very early, usually as soon as the infant exhibits a little colic. Most of these babies consequently do become constipated from such treatment. If the mothers are reassured and are instructed to leave the babies severely alone, the fear of constipation speedily passes, as soon as a few natural evacuations occur. Occasionally, before the habit is fully re-established, use may be made of a glycerin suppository. This treatment must not be continued over too great a period of time, for the fear of establishing the habit. It is only employed to help out, and not more than once or twice a week. I always advise the mother to allow her infant *to go thirty-six hours before she attempts to bring about a movement.* Usually before this period of time has elapsed, a spontaneous evacuation will have taken place.

At times something may be accomplished by a milk analysis and by attempting through the mother's diet to so influence the composition of her milk as to make up for the visible deficiency. Thus, the amount of sugar, fat, and protein may be varied according to the directions already given under Chapter I, page 35. While, of course, quick results cannot be expected from this method alone, it should always be pursued as a very important adjuvant.

It is often of service to administer to these babies, just before feeding, a small quantity of either oatmeal or

Granum water. Between feeding, under any circumstances, boiled water should routinely be offered to all breast babies.

**Constipation in Artificially Reared Infants.**—Constipation is not uncommon in this type of baby. The stools are often hard, dry, and crumbly (Plate VIII), and are expelled by the infant with great straining. Much may be accomplished by *dietetic manipulation.* I find it to be of great service to change the diluent of the milk to *oatmeal-water.* This is especially effective if barley-water or a wheat-flour gruel has been employed previously. In some other cases, where the formula has been boiled, feeding it raw will correct the trouble. Hardly to be recommended as a routine procedure and yet decidedly effective, is the feeding of the formula cold instead of warm. In other cases the result is favorably influenced by *increasing the amount of food* if this has been found to be unusually small in bulk. I have noted instances wherein the concentration of the food was insufficient, *i.e.,* the amount of diluent was greater than the digestive powers of the infant demanded, and entirely too great to permit a sufficient residue to provide for the necessary normal peristaltic stimulus. Thus a very *low protein* may be responsible for constipation. On the other hand a very *high* percentage of *protein,* especially if the formula be weak in fat and sugar and if the protein be highly comminuted, as in eiweissmilch or in buttermilk, or if the protein be otherwise influenced, as chemically by pancreatization or by boiling, may cause constipation with hard, dry stools. Unchanged coagulable cow-protein, on the other hand, when fed in excessive quantities, may cause diarrhea on account of the irritant effect of the undigested masses which result. In these instances a starchy diluent, as barley-water or a thin, well-cooked wheat-flour water, is of

service in checking the diarrhea. The curd may also be influenced by boiling, pancreatization, or by the other methods detailed under Protein Intolerance (Chapter II, page 106).

Infants whose formulas are especially *weak in fat* are commonly constipated, and the condition can be favorably influenced by the addition of cream in gradually increasing amounts. Care, however, must be exercised not to exceed 3½ to 4 per cent. (even this may be too much for certain individuals), otherwise fat intolerance may ensue, with the discouraging evidences of weight disturbance.

Not all cases are benefited by increasing the fat. *Some are made worse,* especially if the fat be split up into fatty acids, which in the presence of lime-salts causes the formation of calcium-soap stools, which are constipated (Plate VII). Excessive fat may cause the formation of a greasy, foul-smelling, constipated stool (Plate VI). These stools contain much fatty acid and often present the odor of overripe cheese. Lime-water should therefore, unless it be used for a special indication, as hyperacidity, rarely enter into the composition of any formula. Personally I have practically discarded it for years, and have not felt the necessity of employing it in any instance except, very occasionally, in cases of pyloric obstruction. These cases of constipation due to an excess of fat are benefited by diminishing the fat or by predigesting it (pancreatization).

Constipation in the bottle-fed is often materially improved by *increasing the amount of sugar* or by changing from milk-sugar to cane-sugar or, still better, to some of the malt preparations, as Dextri-Maltose. The effects of low fat and of low protein, even though the sugar be high, are seen in babies fed upon condensed milk. Many of them

suffer from constipation. The ideal for which to strive is a food combination in which all the elemnets (fat, protein, and sugar) are reasonably represented and in which no one element far exceeds the others. This will not only insure a normal state of the intestinal juices, but will provide a proper nutritional balance. Elsewhere I have stated that almost routinely I employ cane-sugar to provide extra carbohydrate. These cases of constipation constitute one of the exceptions in which I make use of one of the malt preparations.

A diet *rich in starch* is constipating. In fact, this is not at all a bad way in which to favorably influence a state of diarrhea. Many of the patented foods are constipating. The milk diluent may contain too much starch. I have seen constipation result, too, from the use of buttermilk into which an excess of wheat-flour had been incorporated. Therefore the starch must be reduced and the diluent made weaker. In some instances favorable influences are noted where the diluent is dextrinized after the method of Chapin, who adds some diastatic agent, as cereo (glycerite of diastase) or a dram or two of one of the many malt preparations upon the market.

In yet other infants, good results are obtained by changing the diluent completely to oatmeal-water. This is quite laxative in its effect and should in all cases be tried. Many babies will show surprisingly good results from the use of this simple maneuver by itself.

*Fruit-juices* serve an admirable purpose in the bottle-fed, not only on account of their antiscorbutic effect, but also for their influence upon the stools. I prefer prune-juice made by boiling a pound of prunes in a quart of water without sugar. This is palatable, antiscorbutic, and laxa-

tive. Usually from 2 to 3 teaspoonfuls are given once or twice a day on an empty stomach. Other juices, as of the orange, grape, apple, etc., may be employed.

A broth made from vegetables (Chapter III, page 146) is useful in this connection and may be given ad libitum.

As the infant grows older and articles other than milk are added to the diet, other things being equal, the tendency toward constipation is often materially lessened. Therefore, if digestive disturbances are absent and two or three teeth have been erupted, such foods as oatmeal, Graham crackers, whole-wheat bread, and tender vegetables may prove to be eminently useful. Scraped apple may also be fed in teaspoonful doses once or twice daily.

From earliest infancy the *habit of regular evacuations* should be established. The infant's buttocks are brought into contact with a small chamber at definite intervals during the day. As soon as the baby can sit up it should be placed in a chair in the same regular way. Later the habit of having a daily bowel movement should be made an object of pride on the part of the child, who should be early taught that nothing must be permitted to interfere with its response to nature's demands. Rewards, if necessary, should be offered to encourage this, and mild punishment inflicted for failure to obey.

**Older Children.**—Children must be taught to crave wholesome food. It is just as easy to do this as it is to allow them to crave those foods which cause digestive and metabolic disturbances. Vegetables in abundance are not only wholesome, but laxative in their effects. Stewed and seasonable, raw, ripe fruits are valuable adjuncts, but apples must be scraped or very thoroughly chewed. Well-cooked coarse-grained cereals, especially oatmeal, are valu-

able. Cereals which are eaten uncooked, with milk and sugar, are not to be recommended. An abundance of

Fig. 44.—Constipation due to dilated colon (Hirschsprung's disease).

butter and olive oil, if they cause no digestive or metabolic disturbances, is valuable.

Sweets and meats are constipating and, therefore, they are to be largely curtailed. I have, however, met instances wherein diet has no influence at all in relieving the condition. One patient, a little boy, recently came under my observation, who consumed seven or eight apples a day without any effect whatever upon his stools. Such obstinate instances require the use of drugs.

## MEDICINAL TREATMENT.

Where dietary measures fail, the cause of the constipation probably depends upon functional atony or upon anatomical twists, kinks or tortuosities or upon congenital dilatation of the colon (Fig. 44). In addition to drugs mechanical manipulation, which will be discussed later, is often valuable. To rehearse the entire list of purgatives would be time-consuming and useless. I shall only mention those agents which have been useful in my own experience.

I have obtained very encouraging results from the use of some form of Russian *mineral oil.* I have employed the preparation known as Interol or Rusol, marketed by Van Horn & Sawtell, or Squibb's preparation, or Olo. They all act the same and one is as good as the other. This is true as well of the American mineral oils to be found upon the market. These oils are not digested. They are passed as they are taken. They simply lubricate the intestinal wall and cause the contents to slip along easily. They have the great advantage of being tasteless. They are administered from a spoon or placed upon a little water which the child drinks without knowing that the oil has been added. A very small amount of sugar may be added for fastidious children, and the dose offered to them as "sugar-water." Infants receive from 1 to 2 fluidrams once or twice a day, on

an empty stomach. Older children are given about half an ounce. The idea is to administer just enough to secure the proper lubrication which will insure from one to three movements daily. There are no ill-effects. Nor is there any danger of establishing a habit. The only inconvenience noted is that the oil will leak through the anus and soil the clothing, if too much is taken. There is no relaxing effect upon the bowels, and of all permanent agents to be employed for the relief of constipation I firmly believe that one or another of these preparations is by far the best.

**Olive Oil.**—This may also be classed as one of the valuable semimedicinal agents. It is administered *per oram* or *per rectum.* It also possesses valuable food qualities, and is especially useful in marantic children of over 1 year of age. By mouth from ½ fluidram to 2 fluidrams are administered t. i. d. after meals. It is often more readily accepted if given with grape-juice. It rarely disturbs the digestion. It must then be given *per rectum.* By this method valuable results are commonly obtained if the remedy is properly administered and continued over a sufficiently long time. Three to four ounces of the oil are deposited high into the bowel each evening, or every other evening, as the infant is put to bed for the night. A soft-rubber catheter is anointed and gently passed into the bowel for a distance of about eight inches. An ordinary small, infant's, hand rectal syringe is now filled with the warm oil, and the hard-rubber tip is connected with the free distal end of the catheter, and the contents of the rubber bulb are gently compressed through the catheter into the intestine. One or two syringefuls are sufficient (Chapter XIII, Fig. 56, *B*). The baby is diapered and usually, the next morning, there will be found a substantial movement. In some cases this

occurs immediately. Gradually the frequency of these injections may be lessened if the movements show a tendency toward becoming spontaneous, as they frequently do. This treatment is also valuable in older children, a little more oil being employed as well as a slightly thicker catheter, which may be inserted about ten or twelve inches.

**Agar-agar** as such, or employed as Regulin after the method of Prof. Dr. Otto Schmidt, is useful in some cases. It acts by absorbing moisture through the intestinal mucosa and thereby, as the agar-agar swells, increases not only the bulk of the intestinal contents, but makes them more liquid. As a rule I prefer the ordinarily powdered agar-agar as purchased in the shops, to the Regulin, as it is tasteless, the latter being impregnated with cascara sagrada, which makes it bitter. Either, however, is administered in stewed fruit or cereal in 1- or 2- dram doses once or twice daily. The results are not always satisfactory, although in some cases decided benefit is experienced. The material must be mixed with the food during the child's absence.

**Milk of Magnesia.**—This in no sense cures constipation. It is, however, often of value in assisting, especially the bottle baby, across a troublesome period. Thus, until the proper-strength formula is found, many infants are constipated. Often, as previously stated, the condition is remedied by changing the diluent to oatmeal-water. Until this is done or has a chance to act, 15 to 20 to 30 or more drops of Philip's Milk of Magnesia are added to each bottle or to every other bottle, or, perhaps, but once or twice a day, according to effect. The dosage, both in amount and in frequency, is gradually reduced to a nicety—simply to obtain the desired result. It may also be given to breast-fed babies. It is finally omitted.

**Castor Oil** is mentioned simply to impress upon the mind of the student that, while it causes looseness of the bowels, it must never be considered as a remedy to cure constipation. When indicated it is one of the best remedies in the treatment of diarrhea. Its secondary effect is relaxing and constipating. It is simply employed to effectively sweep out the intestinal tract. To this it owes its use in diarrhea and also in cases of constipation where the bowels have not moved for several days and it is desired to cleanse the intestines and to relieve acute or chronic toxemia. Its use must always be followed by tonic laxatives, of which

**Cascara Sagrada** is the best example. The great objection to it, however, is its taste. This may be more or less disguised by employing the aromatic fluidextract in doses ranging from 15 to 45 drops once or thrice daily. Or it may be disguised as follows:—

℞ Liquid extract of cascara (B. P.),
Liquid extract of liquorice (B. P.),
Syrup of orange-peel,
Chloroform-water ..................āā ♏xv.

Or as follows:—

| | |
|---|---|
| ℞ Sodium sulphate ..................... | gr. v. |
| Liquid extract of cascara (B. P.) ...... | ♏iiss. |
| Glycerin ............................ | ♏v. |
| Cinnamon-water ..................... | q. s. |

I have seen the good effect of both of these formulas in the wards and in the out-patient department of the Hospital for Sick Children, Great Ormond Street, London. The latter prescription is slightly more stimulating than the former. Through experience in the same institution I have obtained good results from the following combination of tonic laxatives:—

| | |
|---|---|
| ℞ Tr. nucis vomicæ | ♏ss. |
| Tr. zingiberis | ♏ij. |
| Tr. hyoscyami | ♏v. |
| Tr. aloes | ♏iv. |
| Syrupi sennæ | ♏xv. |
| Dill-water (B. P.) | q. s. |

This is carminative as well as laxative. A small quantity of the fluidextract of cascara could readily be added with advantage.

**Phenolphthalein** is a useful laxative in some cases. It is found upon the market in various pleasant combinations with other laxatives, or alone. The dose varies from ½ to 2 grains.

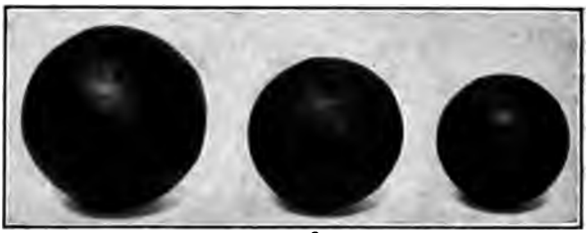


Fig. 45.—Massage balls used by the author in the treatment of constipation. (Physician's Supply Co., of Phila.)

### MECHANICAL TREATMENT.

No case of constipation is properly handled unless mechanical means have been given a trial. Of these *abdominal massage* is of considerable value. In my own experience this is best accomplished by the systematic employment of a massage ball (Fig. 45). It is made in sizes Nos. 1, 2, and 3. They consist of iron covered with leather and weigh, respectively, ¾ lb., 1½ lbs., and 2 lbs. They resemble baseballs. They are made for me by the Physician's Supply Company, of Philadelphia. The size of the ball is selected according to the age and size of the patient.

No. 1 is for infants, No. 2 is for children from 1½ to 2 years of age, and No. 3 for older children. Morning and evening, before the child arises and before it retires, the bladder being at first emptied, the ball is rolled by the palm of the hand in a circular motion, slight pressure being used in addition to the weight of the ball, along the course of the colon, up the right side, across and down the left. This is continued for from ten to fifteen minutes, after which a circular motion is continued for five minutes over the center of the abdomen, over the small intestines. I find that many babies are benefited to no small degree. The treatment must continue for two or three months.

## SPONDYLOTHERAPY.

Albert Abrams, of San Francisco, recommends that in *atonic constipation,* the most common variety, *concussion* or *sinusoidilization* of the spines of the *first three lumbar* vertebræ be practised daily, and in the *spastic variety* the same treatment be applied to the spine of the *last dorsal* vertebra. If the exact nature of the constipation cannot be determined, alternate concussion of these areas is practised at the same sitting. Concussion may be practised by placing a piece of linoleum about ¼-inch thick over the spine. This is then struck light but rapid blows with an ordinary tack-hammer. In lieu of this the middle-finger of the left hand may be placed upon the spine and struck with the closed fist of the right hand, which acts as the plexor or concussor.

# CHAPTER IX.

## DIARRHEA.

THIS affection will be considered largely in its relation to the suckling. Therefore, treatment will be discussed mainly from the standpoint of the breast-fed and the baby fed upon cows' milk.

The splitting up of the fat of the food sets free fatty acids. These normally combine with the alkaline bases of the food and of the intestinal mucus. If these acids be in excess they not only irritate the intestinal mucosa, causing increased peristalsis and an increase in the intestinal mucus, but also cause the intestinal contents to be acid. This acidity favors the development of certain bacteria which require an acid medium. These bring about destruction of the *carbohydrate.* This destruction of the carbohydrate is called *fermentation,* which is distinctly an acid-producing process, and this still further favors the development of acid-producing bacteria and the development of diarrhea.

Destruction of *protein* is called *decomposition* and results in the formation of alkalies. The alkaline medium favors the development of the bacteria of decomposition.

Thus, the interaction between certain food elements and bacteria results in either fermentation or decomposition. In health, within the intestines, each process is proceeding simultaneously. The feces, or the intestinal contents, will be neutral, or slightly alkaline or slightly acid. Neither alkalinity nor acidity can preponderate, the one over the other, to any great degree without resulting in a disturbance

of the circulation of the intestinal mucosa. This results in the pouring out of an excess of mucus and in an increase in the peristaltic action—*diarrhea;* although the effects of excessive acidity are more quickly noted than are those of an excess of alkalinity. This, and also the fact that the presence of mucus indicates an attempt on the part of nature to protect the lining membrane and to neutralize the acid—for intestinal mucus is alkaline—have an important therapeutic significance, as we shall see.

From the preceding it follows that in most cases of diarrhea the stools are acid because *fermentation is more common than decomposition.* Even in the presence of decomposition the irritant effects of the alkaline medium is less. The continuous outpouring of large quantities of mucus causes the infant's nutrition to become seriously impaired because of the loss of great quantities of water and of salts, these being the main constituents of mucus.

It has been seen how the reaction of the intestinal contents determines the nature of the preponderating variety of bacteria, and how this reaction depends primarily upon the nature of the food, *i.e., that there is a reciprocal relationship existing between the food and bacteria and that each is necessary to the other in order to carry on the processes of intestinal digestion.* It is also understood now that the character of the food readily determines the nature of the bacteria.

It may, therefore, correctly be stated that the nature of the food which is given to an infant determines largely the presence or the absence of diarrhea, and that the food assumes at once the dual rôle of etiologic factor and prime therapeutic agent. Clinically this has been proven to be a fact, and most cases of diarrhea in both the breast- and in

the bottle- fed will yield, if not neglected too long, nicely to dietetic management alone and without the use of drugs.

### SYMPTOMS.

As stated, the intestinal contents are more fluid, usually more acid (sometimes more alkaline), and the peristalsis of the gut is accentuated; therefore the bowels move more frequently. At first there may appear but very little change in the physical appearance of the discharges, aside from their thinner consistency. Shortly, however, an excess of mucus is noted. This is, as a rule, very stringy, yet withal intimately mixed with the stool. The latter is at first yellow, then yellow and green, and finally may assume a grass-green appearance, or it may be yellow-and-green mixed. The green color is due to biliverdin, an oxidation product of bilirubin (Plates IV and V). It must not be forgotten that the color of a stool must be noted as soon as it is passed, because all stools, especially those of sucklings, turn green an hour or so after being exposed to the atmosphere. If the process continues the mucus may be blood-streaked or a fair amount of blood may be mixed with the stools (Plate X). If this has originated high up in the bowel it will be dark; if low down it will appear bright and may not be as well mixed. As the case progresses the fecal character of the movements may be lost entirely, it consisting simply of a colorless discharge of water or mucus. These stools are odorless as a rule, and are seen commonly in "summer diarrhea" (intoxication) and are of serious import.

The *odor* of the stool assists in determining the nature of the process existing within the intestine. *In cases of fermentation the odor is distinctly sour and acid, but not*

*unpleasant. In cases of decomposition, on the other hand, the reverse is true, the discharges being foul-smelling.* The reaction may be readily tested with litmus-paper. Further, if the stools are intensely acid their constant exit from the anus is associated with severe excoriation of the skin about the buttocks and the anal region. These cases are particularly common in babies who cannot digest the sugar of their mother's milk, and in bottle-fed babies who are suffering from sugar intolerance.

In cases due to an excess of fat, nature attempts to correct the acidity by causing the free fatty acids to combine with the alkaline salts which are contained in the excess of intestinal mucus. The action is called saponification, and results in the discharge of stools containing large or small, hard, granular masses of calcium soap (Plate VII). These masses are contained in a liquid matrix of mucus. Their presence in constipation has also been noted (Chapter VIII). In these instances all the fatty acids have been neutralized by the alkaline (calcium) bases contained in the mucus—the so-called soap stool (Plate VII). These cases also, in addition, usually exhibit an alkaline, ammoniacal urine.

The stools commonly contain white particles or masses, as well as mucus. Much time and discussion have been wasted in an effort to determine the exact nature of these. Are they constantly protein or constantly fat? Latter-day pediatrists contend that they are always fat; that undigested protein never is pathologic. With this view I cannot be in accord. Unchanged cows' curd (unchanged chemically or physically) is as indigestible today as it was twenty years ago, and may and does in many instances, by its directly irritating effect, produce diarrhea (Chapter II).

Therefore the answer fairly made is that these white masses may be either protein or fat, and that this can be determined in the individual case by the proper test elsewhere described (Chapter II). The stools appear often, under these circumstances, not unlike loosely scrambled eggs (Plate IV).

**Constitutional Features.**—No infant can have diarrhea without suffering as to its nutrition. These babies all lose weight—more or less according to the severity and duration of the process. Thus, in acutely severe cases the loss of a pound or two in twenty-four hours has been recorded. In less severe, but equally obstinate subacute or chronic, cases this amount of weight may be lost within a period of a week or two. The loss is due directly to the loss of water. The tissues become *dehydrated.* Fat consists largely of water. Therefore the plumpness and the roundness of the babe are speedily altered. The tissues are also quickly *demineralized.* Consequently, nervous irritability may indicate its presence by a positive Chvostek reaction or increased electrical reactions (*vide* Spasmophilia, Chapter X, page 276).

In cases of *dyspepsia* and of *intoxication,* fever develops. In the former the range is not so high—from 100° to 101° F. *per rectum,* while in the latter it may register from 104° to 106° F. and the symptoms of intense intoxication may appear. These are: collapse, shallow breathing, sunken eyeballs, sharp features, cold nose, coma, ashen hue about the nose and mouth, albuminuria, glycosuria, rapid and thready pulse, vomiting at times, together with frequent watery evacuations and a tremendous loss in weight (*vide* Sugar Intolerance, Chapter II, page 113).

**Diarrhea or Intestinal Indigestion in the Breast-fed.**—Here one meets a colicky, breast baby, suffering from gaseous distention and diarrhea with yellow or greenish-yellow, loose stools containing stringy mucus and finely chopped up white particles (Plate V). These stools have a slightly pungent, acid, not unpleasant odor. These babies have excoriated anal regions and frequently spit up after feeding. In many the skin is somewhat irritated or there may be present a papular eruption all over the body, or it may be confined to the face. These infants rest poorly and yet, in spite of their discomforts and abdominal objective features, many of them continue to gain weight. They are a source of worry to the young mother and of endless annoyance to the physican, because it is difficult for him to appease the mother with the statement that the infant is all right when she and her friends think that it is all wrong. These cases, in my judgment, are only precarious in so far that they, more than any other, are speedily taken from the breast because the average physician does not understand how to treat them, because the mother demands that something must be done, and because that "something" *usually consists in removing the infant from the breast and putting it upon some indifferently modified formula, instead of attempting to treat it rationally through the mother's milk.* From this point, in many cases, is marked the beginning of a downward course—the feeding of many and varied milk mixtures and patented foods, ending in further digestive disturbances, nutritional disorders, entire food intolerance, and death. Thus I believe that this stool is largely, though indirectly, responsible for the vast infant morbidity and mortality occurring during the first year of life.

## TREATMENT.

**Breast Babies.**— In the cases just cited the maternal milk should be analyzed. If this be impossible it must be assumed that the milk contains *too much fat or too much sugar or both for the individual.* An attempt must be made to readjust these through the mother's diet and through exercise according to the methods described on page 35, Chapter I.

It is primarily important to reassure the mother repeatedly. If maternal mental quietude can be secured the digestion of the infant will be materially assisted. The baby must be weighed thrice weekly in the presence of the mother, who must be made to realize the desire of the physician to deal honestly with her. This instance is an exception to the rule against too frequent weighing. At the same time the mother must be assured that, as long as her baby gains, not very much can be wrong. If once maternal control is secured the problem will be easy, for not infrequently weeks and even months are consumed before the stools become normal in these babies, and sometimes they never do so until weaning is accomplished. For a while the stools may appear quite normal, when they again relapse. The suggestion of Dr. Frank Neff, of Kansas City, Mo., that the maternal milk be drawn and skimmed, I consider a good one, though not always practical.

If vomiting occurs the feeding interval must be lengthened to two and one-half to three hours and even to four hours. The infant must not be kept at the breast too long —from five to fifteen minutes being sufficient. Nor must it receive its meal too fast. The mother can control the flow of milk by making pressure upon the nipple. The infant must not be permitted to suck air, and after each feeding it

is held erect and its abdomen gently compressed in order to assist in the easy expulsion of gas. Many of these babies are benefited by instituting a "hunger period" for twenty-four hours, during which time only weak tea sweetened with saccharin, or barley-water, is given, or by giving them just before nursing a half-ounce or so of plain boiled water or, preferably, thin barley-water. This dilutes the mother's milk, assists in dividing up the curd, and often causes the stools to become normal, at least for the time being. A carminative water, as peppermint-water, anise-seed water, soda-mint water, or dill-water, may be useful in either preventing or curing the colic. A peaceful night may be secured for the entire household by giving the infant a bath, the temperature of which should be between 100° and 110° F.

**Medicinal.**—Occasionally a dose of from 1 to 3 drams of castor oil in connection with a twenty-four hour "hunger period" may, if associated with energetic dietetic treatment of the mother, cut short an attack. I have an impression, growing stronger with increasing experience, that physicians too readily administer purgatives, especially calomel and castor oil, in cases of diarrhea occurring in sucklings. It is true that the purgative sweeps the intestinal tract of the offending substance, but it is, in addition, itself decidedly irritating and may continue the digestive disturbance for some time before it itself is entirely eliminated from the gut. Consequently it takes a considerable time before the relaxed and irritated bowel regains its tone. The danger from this state of affairs is not so menacing in the breast-fed as in the bottle-fed, for the irritant effect of the purgative may be all that is required to induce a food intolerance, the consequences of which may be far-reaching

and even fatal. The "hunger period" would appear to be sufficient, meanwhile permitting the diarrhea to cure itself, *i.e.*, allowing the irritating substance in the food, which causes the disturbance, to act as the purgative, the bowel thus ridding itself of the offending material without the assistance of other irritants. Of the two, calomel and castor oil, the oil is to be preferred as the least irritating. Should the diarrhea continue longer than appears necessary after the withdrawal of the food, and should the toxic symptoms persist in their intensity or be unusually severe at the outset, then a sufficient dose of oil may be administered, but it must not be repeated. Thus it would appear best to advise that all purgatives should, in sucklings suffering with diarrhea, be administered with caution and only after mature judgment.

The following may be administered with excellent effect just before or immediately after food. It may be given in barley-water or in plain water:—

℞ Extract pancreatin,
Taka-diastase ...................... āā gr. ij.
Pul. aromat.,
Sac. albæ ......................... āā gr. iij.
M. et ft. chart. no. j. Mitte no. xij.
Sig.: As above directed.

Especially, if combined with a hot bath, sodium bromid will often soothe the babe to peaceful slumber:—

℞ Sodii bromidi ....................... gr. xxxij.
Tr. opii camph.,
Aquæ menthæ pip., or
Aquæ anisi .......................... ℥iss.
Syr. simplicis .................q. s. ad f℥ij.
M. ft. sol.
Sig.: As above directed or fℨj *t. i. d.* or *p. r. n.* in aqua.

Bismuth and intestinal antiseptics play no part in the treatment of diarrhea.

Should no improvement occur the infant must be removed from the breast and placed upon eiweissmilch or upon buttermilk-and-flour mixture sweetened with saccharin. Meanwhile the breast function is maintained by the systematic use of the breast-pump. When the stools again become normal the infant is again placed upon maternal milk. If, however, one or more relapses ensue, suitable artificial feeding must be instituted.

**Treatment in the Bottle-fed.**—This too is largely dietetic. The following routine has many times yielded good results: An initial purgative of castor oil may or may not be administered, in keeping with the ideas just discussed. Calomel I have abandoned, as its action is too slowly inaugurated; because it is too irritating,, and also because its effect may be constipating and it must therefore be supplemented by castor oil. A "hunger period" of from twenty-four to thirty-six hours is instituted. The infant receives nothing but weak tea sweetened with saccharin (1 gr. to the quart) or barly-water salted to taste and sweetened in a similar manner. Finkelstein's eiweissmilch, also sweetened with saccharin if necessary, is now administered. However, in many instances eiweissmilch is not available in America. I then make use of the Blockley buttermilk mixture, omitting the sugar and sweetening with saccharin if the infant rejects it unsweetened (Chapter III, page 124). This is practically eiweissmilch except that it does not contain the curd of an extra litre of milk. It is, like eiweissmilch, poor in fat, poor in sugar, and rich in protein, which is finely comminuted. It is sterile. It thus provides all that eiweissmilch does and, in addition, it

contains cooked wheat-flour, the starch of which is very valuable in these cases. Furthermore it is much cheaper and very easily made. Instead of either the eiweissmilch or the buttermilk, Larosan makes a very useful substitute. This is highly recommended by Prof. Dr. Wilhelm Stoeltzner (Halle), its originator. It is a calcium casein in powder form. It is a light, dry powder, and is very cheap. This preparation is indicated in all the acute and chronic dyspepsias. It is commonly employed by adding $^2/_3$ ounce to 1 pint of milk and 1 pint of diluent. In weak, debilitated children $^1/_3$ quart of milk and $^2/_3$ quart of diluent may be employed with $^2/_3$ ounce of Larosan. In older children $^2/_3$ ounce of Larosan may be added to 1 quart of whole milk. The effect of this substance, according to Stoeltzner, upon the character of the stools, is often shown within twenty-four hours. Personal experience with this substance has been satisfactory in a dozen or so cases.

Shortly after the use of any one of these preparations, if the case be not too severe and if it progresses favorably, the stools will become thick and present a characteristic dry, crumbly, brownish-yellow appearance. This is the typical eiweiss stool. It consists largely of calcium soap. Its incidence is always a valuable and favorable sign. These preparations are continued for some days. Gradually carbohydrate is added in the form of either cane-sugar or one of the preparations of maltose, as Mead-Johnson's Dextri-Maltose, Loeflund's Food Maltose, or Soxhlet's Nährzucker. The stools are constantly scrutinized and, if they continue normal, the percentage of additional carbohydrate is by gradual steps increased to 5, to 6, or to 7 per cent. This is necessary to maintain bodily heat and to provide for a reasonable gain in weight.

As soon as a gain is inaugurated, other conditions being normal, after omitting one or two feedings, an immediate return is made to some whole-milk formula, the character of which depends upon the age and weight of the child. It is best to start with weak dilutions of skimmed milk, and then to proceed to weak dilutions of whole milk (say 1 part of milk and 3 parts of water) and to gradually increase the strength of the milk. Cane-sugar or some maltose preparation is still employed to provide carbohydrate, and the diluent of the milk should be some starchy preparation, preferably barley-water, wheat-flour water or, still better, arrowroot-water. This provides an excellent means of attenuating the curd of cows' milk, rendering it digestible. The digestibility of the milk may be decidedly increased by pancreatization or by using flour ball and pancreatin, or Benger's Food. If there be a tendency toward looseness of the bowels the sugar should be markedly reduced or temporarily omitted. Meanwhile 5 to 10 grains of fullers' earth is administered internally in order to thicken the stools.

Should there at any time occur a real relapse, the treatment just outlined must be repeated. The danger, however, is that after two or more attacks the strength of the patient is so low that it is impossible for the infant to support another "hunger period," as the tolerance for food of any kind may be so depressed as to prevent the infant from receiving sufficient nourishment to sustain life, and dissolution ensues. In other words, the food tolerance is far below the food minimum (von Pirquet).

Where marked intolerance for sugar does not exist, weak dilutions of Ramogen, somatose milk, and of condensed milk form valuable adjuncts in the treatment of

diarrhea. They are of especial use as go-betweens, as it were, during the period of starvation and the time when a return is again made to skimmed milk or to whole-milk dilutions. Even in cases where sugar can be determined as the primary cause of the intestinal upset, these substances may be of use as tolerance for carbohydrate is again gradually established.

**Treatment Other Than by Diet.**—If the infant has lost much water this must be supplied by the drop-method *per rectum,* by mouth in definite amounts, by the drop-method by mouth, or by hypodermoclysis, according to the urgency of the indication (Chapter XIII). Plain tap-water may be employed, but normal saline solution is perhaps preferable. A solution containing 1 dram of sodium chlorid and 1 dram of sodium bicarbonate to the pint is the one which I commonly employ.

If the temperature be high, especially during the summer months, frequent bathing is essential. It combats shock and soothes the infant's nervous system. The bath should be warm (100° F.) and gradually cooled (80° to 75° F.). The cold bath is abominable. An excellent method is that proposed by Henry Illoway, M.D., of New York, who employs the wet pack, consisting of a sheet wrung out of tap-water. The infant is enveloped in this and permitted to lie in it for hours. When it gets warm or when the infant's temperature starts to rise, the wet sheet is renewed and an ice-cap is kept to the head. The wet pack not only reduces temperature, but has an excellent effect upon the nervous symptoms, causing the infant in most cases to drop off into a refreshing slumber. The etiologic influence of external heat is decidedly mitigated and the pack often seems to assist in the actual reduction of the number of stools.

Colonic irrigation as a routine method of treatment is, in my judgment, of very little use and frequently does harm by increasing the amount of mucus, if it be too long continued. As an initiatory remedy employed but once, it may render signal service in reducing temperature, lessening toxemia, and by ridding the bowel of a mass of offensive material. Likewise in cases of actually demonstrative sigmoidal and rectal ulceration occurring as the result of secondary infection, and in which blood is found in the stools, daily or bidaily flushing of the bowel with a warm 2 per cent. solution of tannic acid is of much value. About 2 quarts should be employed.

Vomiting in the beginning of severe cases of intoxication is a benign process with which no attempt should be made to interfere. Stomach washing is valuable late in the course of severe cases where the vomiting occurs as the result of toxemia. One or two washings may be sufficient. A solution containing 1 dram of bicarbonate of soda to the pint of water is best. It should be used warm. A point in technique may be of considerable service. After the fluid returns clear, the tube is not withdrawn, but a feeding is poured into the funnel and allowed to enter the stomach. The tube is pinched and withdrawn by a swift movement between gags. A meal given in this manner is often retained when otherwise it would be vomited (Chapter VII).

*Medicinal.*—My feeling is that drugs should play a very small part in the management of these cases. To secure rest of the nervous system and to conserve for the infant its energy, a hypodermic injection of from $^1/_{80}$ to $^1/_{100}$ grain of morphin sulphate is decidedly useful. Recognizing that the physician is often forced to administer medicine against his better judgment, those remedies only should be

employed which do the least harm. Calomel and intestinal antiseptics are practically useless and, for reasons already enunciated, should not be employed. Digestants like pancreatin and taka-diastase or a drop of the tincture of nux vomica are at times good and helpful. Bismuth I believe to be inert as to its effects upon this condition, with the possible exception of the subgallate which I have employed in large doses (gr. xx every three hours) in combination with 10 minims each of the tincture of kino, camphorated tincture of opium, and listerine, with cinnamon-water as the vehicle. The mixture was discontinued as soon as hemorrhage was controlled. Czerny employs the juice of dried or fresh blue berries. In older children he administers this with potatoes in the form of a soup. I have in two or three cases of severe bleeding employed, along with tannic acid irrigations, 1/8 grain of emetin hydrochlorid, I think, with good effect.

### DIARRHEA IN CHILDREN WITH TEETH.

The problem is not so difficult. The presence of teeth indicates that the intestinal tract is ready to care for food which requires previous comminution. Therefore the source of the diarrhea, viz., milk, may be omitted from the diet at once. An initial dose of castor oil usually in these children does good and rarely any, or but little, harm. Not less than 1/2 ounce should be administered. Recourse should be had to starches, preferably well-cooked rice (three hours), arowroot-jelly, wheat-flour gruel, farina, cream of wheat, mashed baked potato, stale bread, mutton-broth and soft-boiled egg. While on this diet, which may be continued for weeks, improvement speedily occurs. The digestion may be materially assisted by the use of pancreatin and

of taka-diastase. Two grains of each are administered every four hours. Recovery will in most instances ensue without the use of medicaments. Should these be found necessary some preparation containing tannic acid, as kino, geranium, catechu, or tannigen, will be found to be the most serviceable if used in combination with small doses of paregoric. Fullers' earth (gr. x every four hours) will also thicken the stools. As soon as the latter become normal a return should be made to milk preparations—as eiweiss-milch, buttermilk-and-flour mixture without sugar, but sweetened with saccharin, or skimmed milk, $^1/_3$ diluted $^2/_3$ with arrowroot-water, with the addition of $^2/_3$ ounce of Larosan and the whole sweetened with saccharin. Gradually dilution of whole milk is made and the Larosan is omitted. Sugar is slowly added for a while. Flour ball and pancreatin may be employed, or Benger's Food. Anyway, plain whole milk should be cautiously reached and this should be boiled for some time after the attack. In using skimmed milk under all circumstances this should be employed by skimming the best milk obtainable, at home.

# CHAPTER X.

## SPASMOPHILIA.

**Synonyms.**— Spasmophilic diathesis, Tetany.

**Definition and Nature.**—Under the term spasmophilia are correlated the evidences of nervous irritability in infants and young children which have been known to the profession for a long time. These conditions are mainly *laryngospasm, carpopedal spasm, tetany,* and *convulsions.* Instead of regarding each as a separate and distinct disease with a special etiology and special therapeutics, under the term *spasmophilia,* they have been united as a single entity depending upon a basic cause or diathesis which is determined by certain metabolic disturbances which, though not definitely proven, certainly exist, and which depend upon dietetic errors. Spasmophilia may, therefore, be characterized as a state of abnormal nervous irritability. Most cases occur *after the third month,* although there are exceptions to this, some earlier instances being met especially in premature infants. Rarely, if ever, are cases seen in the breast-fed,—a fact to which much significance must be attached. In the Waisenhaus und Kinderasyl in Berlin over 50 per cent. of the infants which are artificially fed show the evidences of this diathesis. The vast majority of these babies receive eiweissmilch.

### PATHOLOGIC ETIOLOGY.

Before 1890 the spasmophilic diathesis was little understood. Escherich and Lows first noted the constant asso-

ciation of convulsions and laryngospasm with increased nerve irritability.

About the same time Gai and Ganghofner noted the association of eclampsia (convulsions) and irritability of the nerves, and concluded that the former occurred as a consequence of the latter. Thiemich and Mann were the first to study and to measure the electrical reactions of these cases, and to determine the normal number of milliampères which were sufficient to cause muscular contraction. It was discovered that the minimum amount of galvanic current necessary to produce a contraction of a muscle in a normal infant, when the anode was opened, registered 5 milliampères.

Number of Ampères Necessary to Produce Muscular Contraction in a Normal Child.

| | C. C. C.[1] | A. C. C.[2] | A. O. C.[3] | C. O. C.[4] |
|---|---|---|---|---|
| Under 8 weeks ...... | 2.61 | 2.92 | 5.12 | 9.28 |
| About 8 weeks ...... | 1.41 | 2.44 | 3.63 | 8.22 |

Number of Ampères Necessary to Produce Muscular Contraction in Manifest, Latent and Passed Spasmophilia.

| | C. C. C. | A. C. C. | A. O. C. | C. O. C. |
|---|---|---|---|---|
| Manifest ............ | 0.63 | 1.11 | 0.55 | 1.94 |
| Latent ............... | 0.70 | 1.15 | 0.95 | 2.23 |
| Passed ............... | 1.83 | 1.72 | 2.34 | 7.904 |

These figures are averages, but serve to indicate that in the presence of spasmophilia decidedly less current is required to produce the muscular contractions.

Finkelstein first named this state of nervous excitability spasmophilia. Inase, working with Escherich, noted the

[1] Cathode-closing contraction.
[2] Anode-closing contraction.
[3] Anode-opening contraction.
[4] Cathode-opening contraction.

presence of hemorrhages into the parathyroids in many newborn babies, and to the destruction of the parenchyma of these glands, occurring as the result of these hemorrhages, Escherich ascribed the cause of spasmophilia. Finkelstein objected on the ground that, if the causative hemorrhage occurred at birth, it was difficult to understand why, with but rare exceptions, the symptoms did not appear until three months later. He proposed that the cause was due to faulty metabolism by reason of which some substance, which he did not name, entered the blood. He inclined to the view, however, that the salts of the whey of cows' milk were the responsible factors, because it is well known that nearly all cases occur in the artificially reared, and he claimed further that the symptoms could actually be produced by whey feeding. This statement, however, requires confirmation.

Stoeltzner (Halle), after feeding lime to children, decided that this caused the increased nervous response to the electric current, and concluded that with artificial feeding there is an increased accumulation of lime in the system, especially since there is at least five times as much lime in cows' milk as in human milk. This he claimed increased the nerve irritability. On the other hand, Quest found that in the brains of children, dead of tetany, there was a deficiency of lime-salts. His conclusions, therefore, exactly reversed those of Stoeltzner, and he found that dogs, fed upon a diet poor in lime, exhibited diminished resistance to the electric current. In confirmation of this, and also linking together the theory of a disturbance of metabolism on account of impaired parathyroid function with that of lime starvation, MacCallom found a deficiency of lime in dogs in whom the parathyroids had been extirpated.

Up to the present time, therefore, it must be stated that

the exact etiologic factor or factors have not been determined, although it would appear that the *truth lies somewhere between the theory of lime starvation and that of disturbed function of the parathyroids.* The former occurs either as a consequence or as an association of the latter. Much credence must be given to the lime-starvation theory, because, recently, the best results have been obtained after treatment with calcium bromide.

## PREDISPOSING CAUSES.

The fact that the same exciting factor does not induce spasmophilia in every child permits us to assume that *heredity,* as far at least as predisposition is concerned, plays a rôle of no mean importance. The disease is not infrequently seen in many children of the same parents. This in itself, however, offers no convincing proof that the same exciting etiologic influence may be responsible in each case. It has, nevertheless, been noted that parents who present neuropathies are likely to have spasmophilic children.

The disease is commonly confined to those infants who are *artificially reared.* Especially is this true where the feeding has been mismanaged, and where the food, in both quality and quantity, has been incorrect. As a consequence of this, the occurrence of frequent digestive disturbances has interfered with the proper progression of the infant's nutrition and development. Babies who are *underfed,* as well as those who are *overfed,* however, are pre-eminently predisposed to this condition, especially if the malnutrition is associated with chronic digestive disturbances.

All *exhausting diseases,* prolonged infections especially, predispose to spasmophilia. It is also worthy of note that the acute infectious diseases, notably pneumonia, occur

with greater severity in spasmophilics. These cases present the highest temperature, the greatest degrees of toxemia, and consequently the highest mortality. Further, by means of spasmophilia, we have an explanation as to why so many of the acute infections, again notably pneumonia, are inaugurated in many infants by convulsions instead of by the rigor of the adult. The toxin is sufficient to transform a latent spasmophilia into a manifest one.

*Acute digestive disturbances,* as well as *chronic,* may also induce manifest tetany, a term which will be presently described. Thus is explained the occurrence of convulsions in an infant following the ingestion of some indigestible substance. We formerly regarded this as a reflex or toxic phenomenon, but had no means of explaining the method of its production, or why one child escaped and the other did not. The reason is that the infant is spasmophilic, *i.e.,* the electrical excitability of its nervous system is intensified, and the mechanical or toxic irritation, or both, are sufficient to cause this latent status to become manifest.

*Season* exerts some influence. Most cases are seen *between January* and *April.* Many occur in the autumn, and least are met during summer.

*Sex* does not appear to have any effect.

*The association of rickets and spasmophilia* in the same individual can be frequently noted. What interdependence exists between these two conditions has not been clearly established, although their frequent coexistence must be more than coincidental. It is probably true that each depends upon the same disturbance of metabolism that is produced by improper feeding. Both are undoubtedly benefited by codliver oil and phosphorus.

## SYMPTOMS.

These may be classified under two groups:—

*A*. Symptoms of latent spasmophilia, or tetany.

*B*. Symptoms of manifest spasmophilia, or tetany.

Both of these conditions must be carefully studied in order to exercise control over the diathesis, for at any time a latent spasmophilia may be transformed into the manifest type with fatal results. Each has, however, a distinct symptomatology, and each a distinct therapeusis. The treatment of manifest tetany must be prompt, while that of the latent, while just as important, need not be so hasty.

**A. Latent Spasmophilia, or Tetany.**—This is characterized by

1. Certain reflex phenomena.
2. Abnormal electrical reactions.

1. *Reflex Phenomena.*—These are very important in establishing the presence of the diathesis. They must be divided into *nervous reflex phenomena* and *muscular reflex phenomena*. Under the nervous reflex phenomena we have (*a*) facial phenomenon, or Chvostek's sign; (*b*) Trousseau's sign. Under the muscular phenomena are included (*a*) the peroneus reflex and (*b*) the lip sign of Thiemich.

**B. Manifest Spasmophilia, or Tetany.**—This includes

1. Laryngospasmus.
2. Carpopedal spasm.
3. Eclampsia.
4. Hard edema of hands and feet.

There are other symptoms of more or less importance which will be described in their order. Before detailing the features of both latent and of manifest tetany, the following is therefore presented as a summary of the impor-

tant features, in order that they may be crystallized in the student's mind:—

- Spasmophilia, or Tetany
  - A. Latent
    - 1. Reflex phenomona
      - 1. Nervous
        - 1. Facial phenomonon, or Chvostek's sign.
        - 2. Trousseau's sign.
      - 2. Muscular
        - 1. Peroneus reflex.
        - 2. Lip phenomonon of Thiemich.
    - 2. Abnormal electrical reactions.
  - B. Manifest
    - 1. Laryngospasmus.
    - 2. Carpopedal spasm.
    - 3. Eclampsia.
    - 4. Hard edema of hands and feet.

*Facial Phenomenon, or Chvostek's Sign.*—Search should be made for this in every child after 2 months, as it is a constant feature of both manifest and of latent tetany. It may be positive on one side of the face only. Hence both sides should always be tested. It is elicited by tapping lightly with a percussion hammer (plexor—Fig. 46) on the face just below the zygomatic process of the superior maxilla. This is followed by a contraction (sometimes very slight and evanescent, and therefore the most careful scrutiny must be exercised) of the muscles of the face and of the upper eyelids, and of the wing of the nose. The facial contraction may not occur, and the phenomenon may be confined to the upper eyelid alone. Therefore, this portion of the face should be most carefully visualized.

The contraction in any event is faint or intense, depending upon the degree of nervous excitability. The features must be in repose when this test is made, and, therefore, it cannot be successful if the baby is crying. While this sign is present in practically every case of spasmophilia, it is not pathognomonic of this affection. At least the author has been able to demonstrate it in cases of *tuberculous meningitis*. It may be that these infants were spasmophilics as well. However, positive reliance should not be placed upon this sign alone, and every case in which the condition is suspected should be studied for the electrical reactions as well if this be at all possible.

Fig. 46.—Percussion hammer.

*Trousseau's phenomenon* occurs as the result of pressure exerted upon the main nerve and blood-vessel of a long extremity, usually the arm. The pressure is applied either by the thumb and forefinger of the examiner encircling the upper arm, or by tying a band, rubber or otherwise, about the part sufficiently firm to cut off the circulation at the wrist. The reaction, if positive, may not be seen at once. Shortly, however, the muscles of the hand (if the band has been placed about the arm) or foot (if the band has been placed about the thigh) and of the lower arm or leg commence to contract and to cause the extremity to assume the characteristic attitude of carpopedal spasm. If this test is positive it indicates spasmophilia without question. Unfortunately it is not always present and is, therefore, not so

reliable as Chvostek's sign. Further, it causes pain, and parents often object to its use, as it appears cruel and unnecessarily harsh to them. In no case should it be employed until the close of the examination.

*The peroneus phenomenon* is obtained by tapping the peronei muscles on the outer aspect of the leg with the percussion hammer. If positive, this causes the outer aspect of the foot to be drawn up and the toes to be raised and at the same time to be slightly separated. While this reflex is more reliable than Trousseau's, it is not always present, either. On the other hand, stress must again be laid upon the fact that there is never a case of either latent or of manifest tetany in which Chvostek's phenomenon is absent.

*Lip Phenomenon.*—This was first described by Thiemich, and is obtained by tapping the orbicularis oris. This causes the muscle to contract with the result that the lips are closed and slightly protruded and appear as in the act of kissing.

*Abnormal Electrical Reactions.*—Muscular contractions normally occur when the galvanic current is applied to the muscles of the infant. These contractions are designated as follows:—

*Cathode-closing contraction (C. C. C.), i.e.,* when the cathode is applied over the muscle and the anode is placed on the abdomen or upon the back, a muscular contraction occurs when the current is sufficiently strong for the individual muscle, at that time, when the circuit is closed.

*Cathode-opening contraction (C. O. C.)*, the same conditions obtained as just described, and the muscle contracts when the circuit is opened.

*Anode-closing contraction (A. C. C.)*, the electrodes are reversed, *i.e.,* the anode is placed upon the muscle and the

cathode upon the back or abdomen. A contraction occurs when the circuit is closed.

*Anode-opening contraction* (*A. O. C.*), the same conditions obtain as in the preceding except that the circuit is opened.

It is seen therefore that when making an anode examination the anode is placed upon the muscle and the cathode upon the abdomen or back, and when making a cathode examination the cathode is placed upon the muscle examined and the anode upon the back or abdomen. In either instance the electrode which is placed upon the muscle is called the *"different"* electrode and that placed upon the abdomen or back is called the *"indifferent"* electrode. The former must always be three square centimeters in area, and is usually placed upon the median nerve just above the bend of the elbow on the anterior surface of the arm. This nerve supplies the thumb, the index-finger, the middle-finger, and half of the ring-finger, and as the current is applied the muscular contractions in these digits are noted, especially that of the index-finger. The latter must be not less than fifty square centimeters. The so-called normal electrical reaction, indicating the amount of galvanic current necessary to produce a muscular contraction in a normal infant, is tabulated on page 277. *Reference to the same table will demonstrate that, under abnormal conditions, less current is required to bring about a contraction.* These are the so-called *abnormal electrical reactions. They are pathognomonic of latent tetany, and occur, of course, as well in manifest tetany.*

The following will serve as a practical example of what occurs in a case of spasmophilia. The electrodes are so placed, and the switch on the electrical apparatus so ad-

justed, that the cathode becomes the "different" electrode. The absolute size of the milliampèrage required to produce a cathodal-opening contraction is the indicator of the severity of the spasmophilia. Look for the smallest amount of milliampèrage which will produce a C. O. C. Suppose 1 milliampère of current is flowing through the electrode as shown on the milliampèremeter and no contraction occurs. Slowly increase the current. Suppose at 3 milliampèremeters a C. C. C. takes place. With this amount of current the C. O. C. is still negative. Increase the current to 4 milliampèremeters. A distinct C. O. C. is seen. Decrease the current very slowly so that the smallest amount of current which will produce a C. O. C. can be estimated. Let us assume this to be 3.5 milliampèremeters, and it may be further assumed that at 3.3 milliampèremeters no C. O. C. occurs, but only the C. C. C. is present. Result: 3.5 milliampèremeters constitute the smallest amount of current that will produce a C. O. C. In normal children the necessary amount of current to produce a C. O. C. is 5 milliampèremeters, and anything less than this indicates spasmophilia.

By means of these electrical reactions we can best determine the presence of both latent and of manifest tetany. They are present in every case, although, when other symptoms are in evidence, it is unnecessary to search for them in order to reach a correct clinical diagnosis. However, the prognosis and the effect of treatment can be accurately gauged in this manner and, therefore, whenever possible the reactions should be taken at frequent intervals—daily at first, then triweekly, biweekly, and so on. Cards may be kept on file, graphically illustrating the diagnosis and prognosis of an individual case. If accurate electrical studies are impossible, the prognosis and the effect of treatment

may be studied as well, although less minutely, by frequently testing for the Chvostek sign and noting its gradual disappearance.

*Laryngospasmus.*—This is a convulsive state of the glottis in which a crowing sound occurs during inspiration. An attack is frequently inaugurated during crying or from fright. It is commonly seen in older children following pique, temper, or punishment, and who have the underlying diathesis. On the other hand, an infant may be awakened from sleep by an attack. The crowing sound is characteristic. It must be distinguished from a similar sound which occurs in infants but a few weeks of age. This is known as *stridor inspiratorius congenita,* and is differentiated by the age of the infant, the absence of other symptoms and of the electrical reactions, and by the effect of antispasmophilic treatment upon true laryngospasmus. In the latter, following the spasm of the glottis, there is a state of apnea which is associated with tonic spasm of all the respiratory muscles, those of the diaphragm and of the bronchi as well. The child becomes pale and finally blue. As soon as the spasm relaxes, the crowing sound occurs as the air enters the lungs. The attack seldom lasts longer than thirty or sixty seconds. The occurrence of the crow indicates the end of an attack. One attack may immediately follow another, and the number which may occur in twenty-four hours is indefinite, as many as fifty per diem having been noted. Coma and convulsions may be associated phenomena, ending in death. If the crow does not appear the outcome is commonly fatal. Escherich ascribes the death to cardiac failure, although this point has not been accurately established, as the respiratory center may as well be involved in the paralysis. Mothers frequently bring their

babies for treatment because, as they say, "the baby holds its breath when it cries." As a matter of fact, no air has entered the lungs.

*Carpopedal Spasm.*—Tonic contractions of the muscles of the upper and of the lower extremities characterize this symptom. The contractions last for days and weeks, although temporarily they may partially or completely relax. They are so intense that any attempt to straighten the extremities causes crying on account of the pain thereby induced. The forearms are flexed upon the arms and the latter are adducted and lie close to the chest-wall. The hands are sharply flexed upon the forearms and the fingers are flexed as far as the metacarpophalangeal articulation, from which point the phalanges are extended. The thumb is adducted and its tip frequently touches the tip of the little finger.

Under the older classification this condition of tonic spasm of the upper and of the lower extremities was described as tetany, a distinct disease, and not as a manifest symptom of the spasmophilic diathesis, and the appearance of the hand was described as that of a driver reining in his horse. On the other hand, the Germans describe the appearance as "Geburtshelfer's hand," or the attitude assumed by an obstetrician in delivering a child. The hand itself is likened to a little paw of a kitten (Pfoetchanstellung). The spasm may be confined to the hands and feet, not involving the extremities.

The thighs are commonly flexed upon the belly and the legs may be upon the thighs. The feet are sharply extended. They may be in the position of equinovarus. The phalanges of the toes are flexed up to the second and third rows, which are extended. The back of the foot becomes very promi-

nent, and gives the appearance of edema on account of its increased convexity. The under surface of the foot is arched.

Tonic contractions may involve the muscles of the neck and cause the infant to assume the position of opisthotonos. The body may be bent forward, on the other hand—emprosthotonos. The muscles of the forehead are commonly involved and the latter may therefore be wrinkled. The mouth may be puckered (Karpfenmund, or carp's mouth).

*Eclampsia,* or convulsions, occurs in infants as a common clinical experience. This must never be regarded as a distinct disease, but merely as a symptom of an underlying cause or diathesis. Where organic and inflammatory disease of the nervous system, kidney lesions, and epilepsy can be excluded, careful investigation will frequently reveal the presence of the spasmophilic diathesis. As will be detailed later, this fact is of immense importance in the treatment of convulsions, especially in its relation to their prevention, and sheds much new light upon this frequently fatal condition. The convulsions are clonic and nearly all the cases which ordinarily occur in childhood must be included under this caption.

*Hard Edema.*—A peculiar swelling of the hands and feet is a frequent, although not a constant, accompaniment of tetany. It is not a true edema, as pitting does not occur. It is probably a vasomotor disturbance of the skin. The hyperextension of the feet already referred to assists in causing the cushion-like appearance of the dorsum of the feet.

**Other Symptoms.**—Where very severe generalized involvement obtains, ***retention of urine*** and *obstinate consti-*

*pation* may ensue from intense spasm of the sphincters. In the latter instance the abdomen may become much distended. As the spasm relaxes there occurs a discharge of feces and of gas, and the distention may thus suddenly disappear. *Lingual and esophageal spasms* have been noted.

The *pupils are contracted and do not respond to light. Nystagmus* and *strabismus* may also occur. *Spasm of the bronchi* may appear independently of all other features of the disease.

The clinical picture may assume, therefore, the appearance of pneumonia (Lederer). The absence of physical signs, temperature, leucocytosis, and the presence of the electrical reactions of spasmophilia or of the facial or other reflex phenomena, will permit of a correct differentiation.

In manifest tetany, we may encounter *vasomotor disturbances* involving the skin, and resulting in urticaria, erythema, profuse sweating, and intense, though evanescent, edema locally situated or of the entire body. The latter, upon superficial examination, may be mistaken as due to nephritis. *Digestive disturbances* occur both in cases of latent and of manifest spasmophilia.

**Irregular Forms.**—The first symptoms may appear before the fourth month. The order of the appearance of the symptoms may be reversed, *i.e.*, the features of manifest tetany, laryngospasmus, and of the electrical reactions or the other phenomena, which indicate the spasmophilic basis, may appear before the characteristic features of the diathesis are in evidence. Sooner or later, however, these appear, as does the facial phenomenon of Chvostek. The diagnosis is sometimes, therefore, made with difficulty, and must depend upon the results of antispasmophilic therapy.

## DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.

The diagnosis depends upon the typical symptoms just detailed. *Of greatest importance are the Chvostek sign and positive electrical reactions.* The detection of latent spasmophilia depends largely upon a study of these two features and of the reflex phenomena.

*The discovery of the latent diathesis really constitutes the crux of the dagnosis,* for it is distinctive of this condition alone and serves to properly catalogue the symptoms of manifest tetany, which so closely resemble other diseases. These need but be mentioned, for in all a study of the reflexes and of the electrical reactions will render the diagnosis clear. They are *epilepsy, cerebrospinal meningitis, tetanus,* and any other disease in which irritative or convulsive symptoms are prominent features. Reference has been made to the occurrence of a positive Chvostek in meningitis. However, this need cause no confusion, as other symptoms and the information provided by lumbar puncture will permit of a correct conclusion. It is especially difficult, in some cases, where a knowledge of the characteristic symptoms of spasmophilia is lacking, to say that a particular child has or has not epilepsy. This is particularly true of those brief convulsive attacks associated with momentary loss of consciousness, and which are commonly precipitated by anger, fright, or stubbornness, and which so closely resemble *petit mal.* Stridor inspiratorius has already been considered. Laryngospasmus must not be confused with the *convulsive stage of pertussis, laryngeal diphtheria,* and *retropharyngeal abscess.* Many cases of *thymic death,* so called, where no enlargement of the thymus is demonstrable, are undoubtedly due to laryngospasmus.

## PROGNOSIS.

Where recognized and promptly treated, the outlook for permanent and perfect recovery from this disease is excellent. This is not only true of the manifest variety but, with equal emphasis, of latent spasmophilia. Death may unexpectedly ensue, in an otherwise apparently healthy child, from laryngospasmus or from eclampsia. Even in mild cases, which are untreated, complete effacement of all evidences of the diathesis may occur. On the other hand, in these, and also in those energetically treated, remains of the condition may persist into adult life. This is particularly true of Chvostek's sign. It must not be forgotten that, under any exciting factor, the latent spasmophilia which has for years persisted undetected, may be speedily transformed into any one of the dangerous expressions of the manifest type, and with a fatal outcome. For this reason each child should routinely be studied at least for the facial phenomena, if search for the electrical reactions be impossible.

## TREATMENT.

**Prophylaxis.**—As the disease is not found in breast-fed infants it logically follows that every effort should be made to conserve the maternal milk. If this fails, properly directed artificial feeding should be instituted and great care exercised to prevent overfeeding and consequent digestive disturbances.

**Active Treatment.**—This is directed toward (*a*) treatment of the diathesis or of latent spasmophilia and (*b*) treatment of the symptoms or of manifest spasmophilia.

(*a*) *Treatment of Diathesis.*—This is accomplished by proper diet and carefully directed medicinal treatment.

Most cases will recover if placed upon breast milk. Where dependence must be had upon artificial feeding it is necessary to distinguish between those babies which are being overfed and those which are underfed.

*Overfed Babies.*—A hunger period should be instituted for from six to twelve hours. The metabolic processes are thereby rested and a readjustment of the infant's organism is permitted. During this time weak tea, sweetened with saccharin (gr. j to 1 quart), alone may be given. Following this a 5 per cent. solution of some form of cooked flour—wheat, barley, rice, oatmeal, or arrowroot—is administered for eight days. Small quantities of whole milk are now judiciously added, commencing with about 50 grams per diem. This is mixed with the flour solution. An initial loss of weight usually occurs and is of no consequence if not too long continued. Therefore the daily amount of milk is cautiously increased, care being exercised not to provoke an acute digestive disturbance, as this may be responsible for the appearance of an attack of acutely fatal manifest tetany, —for instance, laryngospasmus.

*Underfed Babies.*—A hunger period is here decidedly contraindicated. In an underfed infant an acute alimentary disturbance must be overcome as quickly as possible. Where gray, constipated stools are in evidence (Bilanzstoerung), carbohydrate is lacking in the diet, and its addition favorably influences the progress of the case. For this reason, these cases speedily improve on malt-soup or buttermilk to which sugar and flour have been added (Chapter III, page 123). If the stools and weight curve indicate chronic dyspepsia, sugar is omitted. Each case must be individualized. Intestinal intoxication calls for eiweissmilch and a

*decomposition* must be treated with suitable milk mixtures or breast milk.

*Medicinal Treatment.*—The best remedy, acting practically as a specific, is codliver oil combined with phosphorus:—

℞ Phosphorus .......................... 1 centigram.
Codliver oil.......................... 100 grams.

M. Sig.: f℥j administered over twenty-four hours and increased to f℥iij.

This is best administered one-half hour after meals. If the stools become dyspeptic the oil must be temporarily withheld. The good effect of this treatment is usually manifest after the eighth day. Cure is often effected within three to four weeks, although continuous administration of the oil and phosphorus must be practised for from three to four months. This is true also of cases placed upon the breast, for the latter alone may not be sufficient to produce a disappearance of the manifestations of latent spasmophilia.

In some very mild cases which are receiving cows' milk, it is sufficient simply, in conjunction with the oil and phosphorus treatment, to reduce the daily amount of cows' milk which the infant is receiving. Thus, if this be 800 grams per diem, it may be reduced to 400 grams and the calories thus lost are supplied by flour-gruels.

(*b*) *Treatment of Manifest Spasmophilia.*—The most important symptoms which require active treatment are: (*a*) convulsions, (*b*) laryngospasmus.

*Convulsions.*—Chloroform is not recommended by the German authorities, although in America it is almost routinely employed. When judiciously handled it produces beneficent results and its administration may be continued

cautiously over a prolonged period of time. Of late the best Continental physicians employ *calcium bromid:*—

| | |
|---|---|
| ℞ Calcium bromid | 10 grams. |
| Aquæ destill. | 200 grams. |

M. Sig.: From 2 to 3 grams (½ to ¾ dram) to be administered daily.

If the soporific effect be too persistent, less may be employed or the drug may be temporarily suspended.

Though not as valuable, *chloral hydrate* may be substituted for calcium bromid if this chemical is not to be had:—

| | |
|---|---|
| Chloral hydrate | 2 grams. |
| Aquæ destill. | 100 grams. |

Ten grams of the solution are equivalent to 0.2 gram of chloral hydrate. This is administered by mouth every two hours or ½ gram of chloral hydrate may be employed per rectum as follows:—

| | |
|---|---|
| Chloral hydrate | 1 gram. |
| Gum-arabic | 5 grams. |
| Aquæ destill. q. s. ad | 50 grams. |

This represents two doses. Personally I favor, and have obtained prompt and permanent effects from, the administration of *morphin:*—

| | |
|---|---|
| Morphinæ sulph. | 1 centigram. |
| Aquæ destill. | 50 grams. |

One fluidram of this solution equals 3 milligrams, which is the dose. The best effects, however, are probably secured by administering the drug *hypodermically* in the dose of from $^1/_{200}$ to $^1/_{80}$ grain.

*Gastric lavage* should be practised if the history indicates a recent dietary indiscretion, especially if sufficient time has not elapsed to permit the food to have passed from

the stomach. While the tube is still in place, if the child be unconscious, a dose of castor oil may be administered in this manner. On the other hand, a dose of bromid and chloral may also be given in this way. Colonic irrigation should be practised at least once. In other words, by mechanical and medicinal means it should be positively ascertained that the gastrointestinal tract has been thoroughly cleansed.

The treatment of an attack of laryngospasmus differs in no important essential from that of convulsions.

# CHAPTER XI.

## EXUDATIVE DIATHESIS.

**Definition and Nature.**—To the German pediatrists, especially to Czerny (Berlin), belongs the credit of crystallizing, under this term, which clearly represents a disturbance of metabolism, an ensemble of familiar clinical phenomena occurring with great frequency in infants and children. The condition is characterized by the frequent incidence of *fibrinous* or *exudative inflammatory processes which attack principally* the *skin and mucous membranes.* These processes appear as *eczema,* and as *catarrhal involvement of the respiratory and gastrointestinal tracts,* respectively. Many of these patients suffer from nervous disturbances as well. The lymphoid tissues may exhibit chronic enlargement. Decided interference with the bodily nutrition may be noted in some cases.

### ETIOLOGY.

**Predisposing Factors.**—Although not manifesting itself immediately after birth, in all cases the condition is, in all likelihood, *congenital.* The exudative diathesis itself is a latent process. It is, as it were, a foundation upon which infection is easily implanted and rapidly develops. Thus, while the various evidences of inflammatory disease of the skin and mucosæ constitute an essential portion of the clinical picture of the condition, they in themselves are not entirely due to the diathesis. Without infection brought to the parts by carelessness, accident, or filth, they could not occur. It is maintained, however, that without the presence of the

underlying diathesis, the infection would not develop. *Thus, a reciprocal relation existing between the diathesis and the infection brings the manifestations of the disease into existence.* To further elucidate this point it may be stated that, according to the German idea, infections of the human body occur in two ways, viz., (*a*) *enteral infection* and (*b*) *parenteral infection.* The former means the entrance of the infective agent through the intestines and is represented by typhoid fever, amebic dysentery, etc. The latter represents the entrance of the infection through avenues other than the intestinal tract; for instance, through the skin, as represented by eczema and erysipelas, and through the respiratory tract, as represented by laryngitis, bronchitis, and pneumonia. It is largely through these parenteral infections that the exudative diathesis becomes manifest. In other words, it is the predisposing factor. Some parenteral infections may even cause other manifestations of the diathesis, already present, to improve, while others intensify the symptoms. Of the first instance we have an example in the beneficent effect of an attack of measles upon eczema, and, of the second, it is well known that vaccinia and varicella will accentuate the symptoms of this disease. Therefore, unless the circumstances be unusually urgent, an infant with eczema should not be vaccinated. It may be surmised, correctly, that there exists a resemblance between the clinical behavior of the exudative diathesis and that of spasmophilia. The latter, as we have seen, may be latent and becomes manifest only as the result of some exciting factor.

The association of the exudative diathesis with spasmophilia occurs with some frequency in the same patient. The relationship is not clear. The event is probably a co-

incidence, although the underlying factor in each instance is metabolic.

*Heredity* undoubtedly plays a rôle of importance. Many children of the same parents present the symptoms of this diathesis. The parents themselves, more or less constantly, present evidences of perverted metabolic processes. They are frequent victims of neurasthenia or of some neurotic manifestation, or suffer from lithemia, the so-called uric acid diathesis, rheumatism, diabetes, asthma, acidosis, indicanuria, or chronic skin affections. *Environmental influences,* however, may explain these results as well as heredity, as the disturbances, evident in the parents, may be due to dietetic and other determining factors which are permitted to operate constantly in the case of the offspring.

The disease is not confined to those artificially reared, the evidences of eczema, especially, occurring, with much frequency, in the breast-fed.

*Unhygienic surroundings,* as already intimated, constitute a predisposing factor of no mean importance. Therefore poverty, ignorance, overcrowding, and filth in every form must be considered. For this reason, too, the disease is more common in the city than in the country.

**Exciting Factor.**—The exact cause is not known. Between pediatrists and dermatologists there exists a difference of opinion as to whether the skin manifestations are constitutional or local. The latter view is held by the dermatologists, who proclaim the futility of any but local treatment. The proper solution will, no doubt, determine that both local and constitutional causes are operative. There undoubtedly exists a reciprocal relation between the underlying diathesis and infection. Upon what does the

diathesis depend? As yet this has not been clearly defined. Czerny regards a *disturbance in the fat metabolism* as the underlying factor, but is unable to exactly describe the nature of this disturbance. On the other hand, Finkelstein inclines toward the view that the error lies with the *water and with the salts.* This finds some confirmation in the fact that certain breast-fed babies, who are gaining but slowly and who have eczema intertriginosum, are benefited by feeding to them the finely comminuted, coagulated protein of cows' milk, with salt, in addition to giving them the breast.

In this instance the fat will not have been removed from the diet. Finkelstein also suggests, as a possible cause, *a disturbance in the nitrogen metabolism* in which too little nitrogen is absorbed. In any event it may be stated that somewhere in a perverted metabolism lies the cause and somewhere in diet lies the cure, because all cases are decidedly benefited by changes in the food and in the external surroundings.

Because of the enlargement of the lymphatic glands, not infrequently met, the relationship existing between this condition and the status lymphaticus has been considered, but the connection is not clear.

## SYMPTOMS.

In order to attempt some form of classification these will be discussed under (*a*) *body weight,* (*b*) *skin manifestations,* (*c*) *respiratory phenomena,* and (*d*) *digestive symptoms.* It is important to emphasize that both treated and untreated cases vary in their severity throughout the course of the attack, and apparently without the influence of external agencies. One set of symptoms will often

ameliorate while another set, hitherto quiescent, will become intensified. The occurrence, therefore, of substitution phenomena is a part of the natural clinical picture of the disease. Thus, the skin symptoms may entirely disappear, to be followed by an attack of asthma or digestive disturbance, and these in their turn will be succeeded by an attack of eczema.

**Body Weight.**—Two types of patients are affected: *Underfed babies* and *overfed babies.* It is important to distinguish these two types, as experience has shown that, originating from this premise, two different lines of dietetic management are necessary to secure good results. Reference will again be made to this classification. In general it may be stated that the underfed baby is thin, puny, and "transparent," is stationary in weight, and likely to suffer from digestive disturbance and diarrhea. It often suffers from eczema seborrhœicum universale, with intertrigo.

The overfed infant appears fat and robust. These babies are, however, commonly anemic, have poor resistance, and exhibit the wet forms of eczema, especially of the face and head. They also have more or less digestive disturbance and may be constipated.

**Skin.**—The dermal phenomena may be classified as *neuropathies, eczemas, pruriginous inflammations,* and *strophulus.*

The first are seen as *increased vasomotor irritability* and exhibit themselves, not uncommonly, as alternate flushing and paling of the surface, without apparent cause. This gives rise, at times, to the diagnosis of anemia (pseudoanemia), an examination of the blood showing its hemoglobin content to be normal. Fugitive erythemas, itching,

exanthemas, pruritus, urticaria, and dermographia constitute the more common remaining skin neuropathies.

The *eczemas* are usually found during the first year. Frequently they develop during the first weeks and even days of life. They rarely last beyond the end of the second year. Two principal types, of which there are several variations, exist: *Eczema seborrhoische universale, or universal seborrheic eczema,* and *eczema of the face and head.* The latter may occur with the universal type.

*Eczema Seborrhoische Universale.*—This develops as a consequence of increased epidermal desquamation, and exhibits white or yellow scales which are more or less filled with inspissated sebaceous matter. It may appear upon the head and forehead and about the temples and eyebrows, or it may become diffuse and cover the entire body with scaling plaques. The oily nature is best noted upon the scalp on account of the abundance of oil-glands in this situation. On the body cracks or fissures occur, and from these exude serum and blood which dry and form crusts. The covering of the scalp may be a complete mask in which the hair is matted in an untangleable mass (gneisz).

A form, in which the scalp is simply covered with more or less oily scales, but in which the underlying skin is not inflamed, also occurs. Removal of the crust reveals only a pale surface and there is no bleeding. This is known as *seborrhea capitis.* Itching is slight. On the other hand, should the skin beneath be red and angry, and itching be intense, then true *seborrheic eczema* is present. This is a dry type of eczema, and rarely is severe.

*Intertrigo, or eczema intertriginosum,* in nearly all cases follows or accompanies eczema seborrhœicum. It is the same process except that it is found in the folds of the skin,

particularly at the joints, in the front part of the neck, and in the groins and behind the ears. The last is an especially common situation. In the groin it must not be confounded with simple maceration and slight irritation of the skin resulting from acid stools and urine and carelessness. This type is moist, while eczema intertriginosum is frequently dry and the skin is always infiltrated or thickened and readily cracks. It may be mild or severe. These infants are often weak and under weight, and have mild, dyspeptic stools.

Closely resembling this type of eczema is *erythrodermia desquamativa, or Leiner's disease* (Vienna). Finkelstein and Moro regard them as identical. Rarely eczema intertriginosum becomes infected with the diphtheria bacillus, when it assumes the clinical features of this disease.

*Eczema of Face and Head.*—This type occurs most commonly after the fourth month. Careful observation will detect its presence almost at its inception. All infants with "red cheeks" should be objects of suspicion. *Normally the cheeks of infants are not red.* They possess the healthy skin color. This is true also out-of-doors. In this type of eczema there is seen a more or less circumscribed area of redness on one or both cheeks. At first glance, and always to the untrained eye, it may appear as the blush of health.

The skin, however, will be observed to be somewhat inelastic, at times shiny, and to be covered with very fine scales. It itches but slightly, as a rule. The process may be stayed in its further development. Later papules may appear and itching may become so intense that the infant unmercifully tears its own flesh, causing it to bleed. Crusts are formed and infection is not uncommon. Many of these

babies are transformed into pitiful sights, and suffer intensely from the scratching and tearing and crust formation. If their hands are tied they bury their heads into the pillow or rub them against any object in their frenzy to secure relief. Removal of the crusts (*milk crusts, or crustalactea*) is followed by bleeding. The skin of the rest of the body may appear quite normal.

Sometimes, instead of papules, vesicles appear (*eczema vesiculosum*) or their place may be taken by pustules (*eczema vacciniformis*). This differs from *eczema vaccinatum,* which is due to, and occurs around the area of, vaccination.

*Phlyctenular conjunctivitis* and *keratitis impetiginosum* are regarded by Czerny as eczema of the cornea. They occur in weak, anemic, underfed infants, and place a grave prognosis upon the final outcome of the disease. Heubner and Finkelstein deny the relationship of this condition to the exudative diathesis.

*Pruriginous Inflammations.*—The staphylococci which normally inhabit the skin may become pathogenic, as a result of the lowered resistance due to the exudative diathesis, and thus be responsible for pruriginous inflammatory processes. The most common expressions of this condition are furunculosis, ecthyma, and infected pemphigus.

*Strophulus.*—This appears in older infants and children as a rule. It resembles urticaria in the sense that the lesions may appear as wheals. They are not as evanescent, however. More often they occur as simple small papules on the apices of which appear minute, deep-seated vesicles. The lesions occur anywhere on the body, most often, however, on the extremities and buttocks. They itch intensely and seriously interfere with the child's rest. If the minute

vesicle is punctured the degree of itching is decidedly ameliorated. They are made decidedly worse by filth.

**Respiratory Symptoms.**—*Catarrhal involvement of the respiratory mucosa* is a cardinal feature of the exudative diathesis. A tendency toward recurrence of these attacks is their most significant characteristic (the so-called "recurrent sibilant bronchitis" of American writers). *Rhinitis* is common as well as *pharyngitis* and *follicular tonsillitis* and *chronic tonsillar enlargement.* *Bronchitis,* which not only, as just stated, frequently recurs, but which is likely to become subacute or chronic, is constantly seen. These frequent infections are no doubt responsible for the many children who present enlargements of the submaxillary and cervical lymphatic nodules. The majority of these enlargements are probably tubercular. This is true also of the enlargements so commonly found at the roots of the bronchi. Infection in both instances is the result, undoubtedly, of the frequent "colds" to which patients with the exudative diathesis are subject. This disease therefore becomes one of considerable importance in the consideration of the prophylaxis, not only of glandular, but of pulmonary and of all other types of tuberculosis.

"Bronchial asthma," or *recurrent sibilant bronchitis,* to which reference has already been made, a disease but little understood as to its etiology and certainly less so as to its therapeutics, is regarded by the Germans as being, especially in infants and young children, a neuropathic expression of the exudative diathesis affecting the bronchial mucosa. Right or wrong, it matters little as long as a new thought with reference to this vicious and puzzling malady is suggested. The diet therefore, as indicated later, should be intelligently handled. Perhaps, then, this disease may

offer another example of a serious affection yielding to a simple remedy which has long been close at hand, but which has remained unrecognized.

**Digestive Symptoms.**—*Lingua geographica* (Fig. 47) is a common occurrence and is prima facie evidence of the presence of the diathesis. It is a thickening of the epithelium covering the tongue, and assumes the form of a whitish elevation which changes in shape from day to day. Oral

Fig. 47.—Lingua geographica.

infections, as *stomatitis* and *canker,* likewise occur. The breath is heavy and often has a sweetish odor. The bowels are commonly normal, but may be constipated. The thin, dyspeptic stools of the newborn, breast-fed baby are regarded by Czerny as due to this diathesis. My own experience would lead me to believe that this is not so in the majority of instances. The intestinal mucus may reveal *eosinophiles* (*eosinophilous stools*). Dyspeptic stools are commonly met in the weak, underfed infants who suffer from eczema intertriginosum.

**The Blood and Nervous System.**—Some of these babies exhibit symptomatic anemia. In most all, the *eosinophiles are increased* to as high as from 20 to 30 per cent. Especially is this noted in cases with eczema. The connection is not clear. Whether the eosinophilia depends upon the eczema, or both the eczema and the eosinophilia depend upon the underlying factor, has not been determined. Various nervous symptoms appear from time to time, as night-terrors, chorea, urinary incontinence, etc. These are not to be regarded as the direct manifestations of the diathesis, but occur from other exciting factors operating upon a weakened system.

## DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.

From all that precedes, the physician will immediately recognize that he has seen, and is seeing daily, many of these infants and children. In the past he has failed to classify them, failed to recognize that, without a correct conception of the underlying diathesis, his attempts to thoroughly cure these babies of eczema and other infections have been signally fruitless. On the other hand, he has succeeded blindly, applying his remedies empirically, but without the stimulating effect upon himself which comes from doing things for a reason. Granting that, even with the recognition of the exudative diathesis as a clinical entity, much concerning its intimate nature remains lacking, we are at least provided with a basis for correct reasoning. Consequently with an attempt toward a correct therapeutic *régime* we are rewarded in some very obstinate cases with brilliant results. There remains nothing from which it is necessary to distinguish this diathesis.

## PROGNOSIS.

As before stated, the severity of the manifestations of the diathesis varies constantly without the influence of external agencies. The substitution phenomena already mentioned must be borne in mind. Eczemas are rarely fatal, although they may be, especially in the presence of severe secondary infection. I have seen fatal pyemia result. The outlook in respiratory conditions depends on their severity and frequency and the general condition of the patient. The possibility of *tubercular infection* must be remembered. Frequent attacks of follicular tonsillitis lead to chronic hypertrophy and *cardiac disease.* The possible extension of the effects of the diathesis into adult life, in the shape of rheumatism, eczema, gout,[1] diabetes, asthma, and other affections of undoubted metabolic origin, is not at all unlikely.

## TREATMENT.

**Prophylaxis.**—A change from the city to the seashore or to the country is of supreme value in hastening the cure. The utmost cleanliness should be observed in handling the eczemas. Even without any evidences of skin involvement the latter should in every way be thoroughly cleansed, properly dried, and protected from infection and filth. The proper care of anal and urinary discharges is particularly important. I have learned to appreciate the value of daily inunctions of cold cream for purposes of cleanliness, instead of water, in cases where the skin exhibits the least irritation or is already involved.

**Underfed Infants with Eczema Intertriginosum and Eczema Universale.**—In the breast-fed it is necessary to add *protein* and *salt* to the diet. For this purpose, while continuing the breast, either plain sodium chlorid, 15

grams daily, are given, or the same amount of "emsersalz" (equal parts of NaCl and $NaHCO_3$). This is given with Larosan or Nutrose. The former, as previously stated, is calcium casein and the latter is sodium casein. These preparations are added to water or diluted milk, in which the salt is also placed. They may be sweetened if necessary with saccharin. They are given for every other feeding. Locally fullers' earth is applied to the skin lesion with very good effect.

In *artificially fed children* who are under weight, reduce the fat and feed the child with eiweissmilch or Larosan made up with milk, whole or diluted. After the dyspeptic stools become normal a formula low in fat and containing starch- or a cereal- water or gruel may be substituted.

*Locally* if the lesions are at all moist the application of fullers' earth is followed by a happy effect. On the other hand, the preparations of tar serve well in many instances. In seborrhœa capitis nothing does quite so well as a thorough cleansing with tincture of green soap, each morning, subsequent to the application of the following for twenty-four hours:—

| | |
|---|---|
| Ac. salicylic. .......................... | gr. vj-x. |
| Ung. aquæ rosæ or lanolin ............ | ℥j. |

Under the influence of this simple ointment the cracks of eczema seborrhœicum and of eczema intertriginosum speedily disappear and the infiltrated areas are made softer, less thick, and more pliable.

**Overfed Children with Eczema of Head and Face.**— In these cases the *total amount of food must be reduced as well as the quantity of fat and carbohydrate.* These children should be fed almost exclusively on a diet consisting of vegetables, cereals, and eggs. Some children exhibit an

intolerance for egg-albumin and are made worse thereby. This may be determined in some cases by performing a test upon the skin exactly as the von Pirquet tuberculin reaction is done, except that egg-white is rubbed into the scarification instead of tuberculin. If the child is sensitive to this form of protein an area of erythema will surround the scarification upon which the substance was deposited (Allergy). Very little, if any, milk should be given. With some babies, even eggs must be omitted. If milk is used at all, it is best given skimmed. In the dry forms of eczema the ointment above detailed is of service.

The *wet types* of eczemas do well on *eczema soup,* which must be administered for from four to eight weeks. This soup is made as follows: Coagulate 1 litre of milk. Allow the whey to thoroughly drain off. Finely comminute the curd by pushing it through a hair-mesh sieve. Add it to 200 grams of whey and further add sufficient water to make 1 litre, and sweeten with 1 tablespoonful of cane-sugar or 1 grain of saccharin.

Marked amelioration is invariably noted after the administration of this preparation for just one week. It is well now to make use of additional carbohydrate and some vegetables and a cereal. Spinach, mashed carrots, stewed celery, stewed onions, oatmeal, farina, and cream of wheat are examples of the types of food to be allowed. The extra carbohydrate should consist of either cane-sugar or some preparation of malt-sugar.

*Locally,* when the eczema becomes dry, a tar ointment should be employed.

Czerny, besides recommending a change in climate, orders the following *régime* for a child weighing 8 kilograms:—

A.M.—A simple biscuit cooked in 100 grams of milk.

Forenoon.—200 grams of whole milk and thin oatmeal-gruel, half and half.

Noon.—Soup and vegetables.

Afternoon.—200 grams of whole milk and thin oatmeal-gruel, half and half.

P.M.—100 grams of whole milk, thickened with cereals. In severe cases the milk may be still further reduced.

**Recurrent Bronchitis.**—It has been possible in several instances to cure and to prevent a recurrence of attacks of bronchitis, associated with dyspnea and sibilant râles, by adopting the following routine: In the beginning *milk, butter,* and *sugar* are entirely excluded from the diet. Dependence is placed entirely upon *vegetables, cereals,* and *meats without fat.* Raw and stewed fruits are not permitted. Sweetening is obtained by the use of saccharin. The bowels are kept regular by enemas and by mineral oil. All external sources of irritation, whether physical or psychical, are avoided. An open-air existence must be secured, and regular bathing, provided there be no eczema, must be practised. Very gradually the forbidden articles of food are added to the diet, one at a time. At the first suggestion of a recurrence, however, they are again rigidly excluded. It has been possible to demonstrate almost absolutely the *influence of diet* upon the recurrence of attacks, in several instances, and in others it has been possible to demonstrate the *negligible effect of season.* Certain children who have each winter suffered from recurrent bronchitis have been kept entirely free when the diet has been rigidly enforced.

Supposing that the metabolic disturbance results in an acidosis from the effects of which the bronchitis arises, the use of from 1 to 2 drams of bicarbonate of soda, scattered throughout the food each day, has been practised with good effects. Other alkalies, like potassium or sodium acetate or citrate or sodium salicylate, are commonly administered in conjunction with the dietary treatment. During an attack, use is sometimes made of small doses of tincture of belladonna, with good effect.

## CHAPTER XII.

### PYLORIC OBSTRUCTION.

**Synonyms.**— Congenital pyloric stenosis, Congenital hypertrophic pyloric stenosis, Pylorospasm, etc.

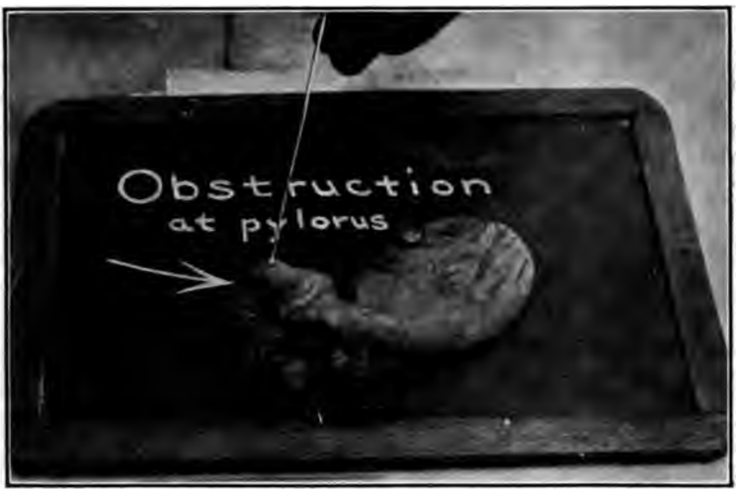



Fig. 48.—Showing pyloric obstruction.

**Nature.**—In order that this affection may be the better understood it appears to me that the synonyms above should be omitted from medical literature and that the disease should be known as (*a*) *infantile pyloric obstruction complete* and (*b*) *infantile pyloric obstruction incomplete.* In all cases there is an obstruction at the pyloric ring (Fig. 48). This prevents the onward movement of the gastric contents into the duodenum from taking place, either completely or incompletely, depending upon the degree of

obstruction. With this conception, a better understanding of the clinical phenomena is available and a more rational therapeutic classification is also possible, as we shall see.

### PATHOLOGY AND ETIOLOGY.

**Predisposing Factors.**—Age, sex, neurotic parental temperament have all been studied statistically as to their bearing on this condition, but they serve no purpose in either prevention or in cure, and will not, therefore, be further discussed.

**Active Factors.**—The cause of the obstruction in every case is a narrowing or a practical obliteration of the lumen of the pylorus by (*a*) *hypertrophy of the pyloric muscle* or (*b*) *spasm of the pyloric muscle* or (*c*) *a combination of both hypertrophy and spasm.* The last is, in all likelihood, most commonly present. Bearing these underlying anatomic features in mind, it is perfectly easy to understand the succession of symptoms characteristic of the two types of this affection, which are met clinically. Reference will again be made to this point.

Much as a clear understanding as to the ultimate direct cause of the hypertrophy or of the spasm would assist in adopting perhaps antenatal or postnatal preventive measures or even curative ones, at present, no definite data bearing on this point are available for practical purposes, although many theories, ingenious and otherwise, have been offered. These I shall not discuss, for a medley of divergent opinions cannot possibly serve any useful purpose and will only yield confusion. My view, based upon the observation of two dozen or more cases, is that in essentially all of them the *initial condition was spasm, and that hypertrophy followed as the result of intense, continuous muscular*

*activity,* and I am beginning to feel that perhaps something, either in the mother's milk or in the intestinal and gastric juices or in the resultant of the activity between these juices and the milk, is responsible for the initial spasm. Therefore I believe that our investigations in the future as to the fundamental cause of the primary spasm will have to be sought in this direction. My reasons for this belief are: (*a*) *most cases do not show symptoms immediately after birth, but perhaps anywhere from two to four weeks;* (*b*) *the degree of spasm is not always the same in a single case, indicating that the local irritant of the nervous mechanism of the pylorus varies in its intensity;* (*c*) *complete non-operative recovery is possible, the symptoms of obstruction sometimes subsiding with comparative suddenness and this, in some cases, has been hastened by a change in diet.* For our purpose, at present, it is sufficient to remember that the pylorus is either completely or partially obstructed, and that either one of these conditions may be brought about by spasm, hypertrophy, or both. Thus it is conceivable that the spasm may be so intense and permanent as to cause complete obstruction, just as well as one may imagine a partial obstruction due to hypertrophy alone (rare) if the hypertrophy were not sufficient to entirely occlude the lumen. Hypertrophy *per se* may cause complete obstruction. So, too, the spasm may be intermittent when either alone or combined with hypertrophy, causing the obstruction to be intermittently complete and incomplete. Clinically we shall see that this is well borne out. Thus any combination of spasm and hypertrophy may exist. *The essential thing, however, as far as subsequent treatment is concerned, is to study these cases clinically, disregarding in a sense the pathology, and to determine in the individual case whether*

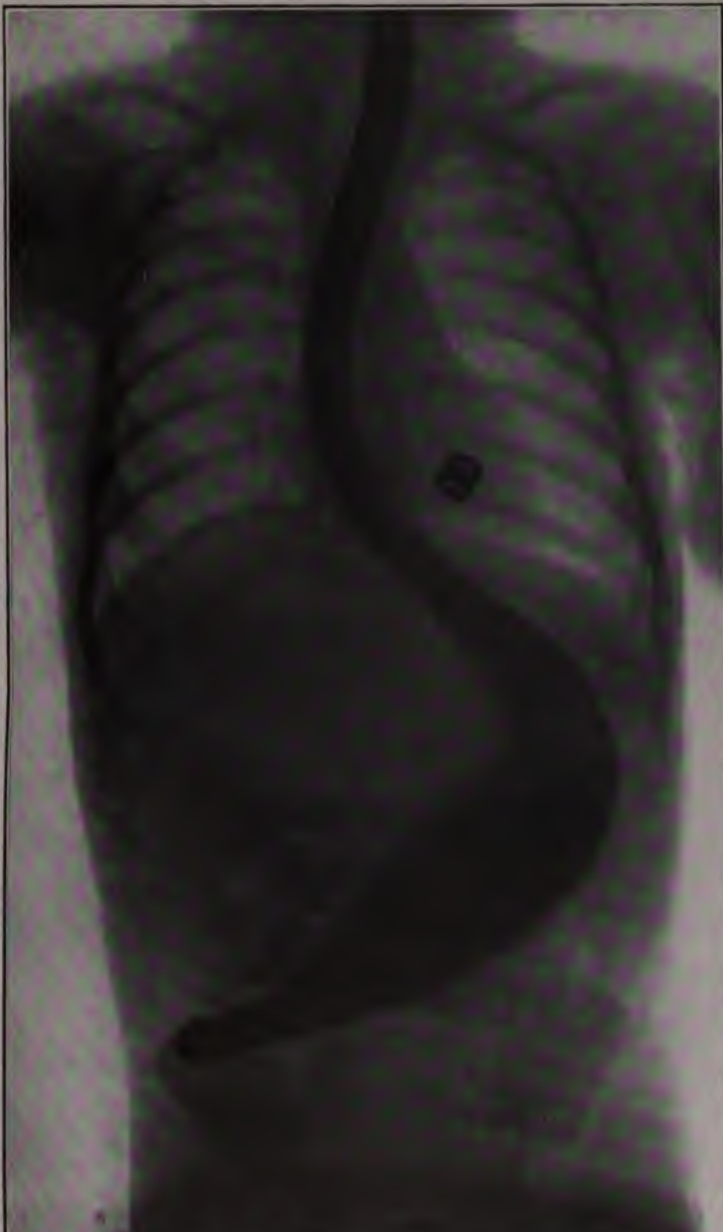
*the obstruction be complete or incomplete and, if the latter, whether enough food passes to sustain life and to warrant a continuance of non-surgical treatment.* Reasoning from these data, the symptomatology may be rationally discussed as follows:—

## SYMPTOMATOLOGY.

**A. Complete Obstruction.**—This is the less common of the two varieties. *Vomiting* results directly from the obstruction. The food cannot get through the obstructed pylorus, so it is ejected through the cardia, after remaining in the stomach a variable length of time. It is the latter phenomenon which often causes confusion and error. One might imagine that if the pylorus is completely occluded the vomiting must occur after each feeding. This is not so because the stomach becomes dilated and its capacity may become enormous (Plate XIII). Thus vomiting may occur but *three to four times or less, per diem.* Especially is this true after the condition has existed some weeks. Therefore, the *amount* vomited *is important.* It may represent three or four or five or more feeds, and be sour and bad-smelling. Vomiting may, however, occur after each feed.

The *manner* in which the food is ejected is characteristic. It is *forceful, propulsive, projectile!* The vomitus literally shoots out of the mouth, and often through the nostrils as well. If very acid it may cause the infant to cry or set up a coryza. The stream may reach a foot or more beyond the crib. It occurs without nausea, gagging, or any apparent effort on the part of the infant. Vomiting may commence immediately after birth. More often it is delayed until the second or third week. It is one of the prominent causes for removing the infant from the breast when the fault lies not

PLATE XIII



Showing stomach-tube *in situ* in case of intense gastric dilation. The tip of the tube is opposite the right superior spine of the ilium and the lower border of the stomach is at the brim of the pelvis. This case made a complete non-operative recovery.

with the maternal milk, but depends upon an unrecognized obstruction at the pylorus. The further history of these babies usually is that they are placed upon an indifferently

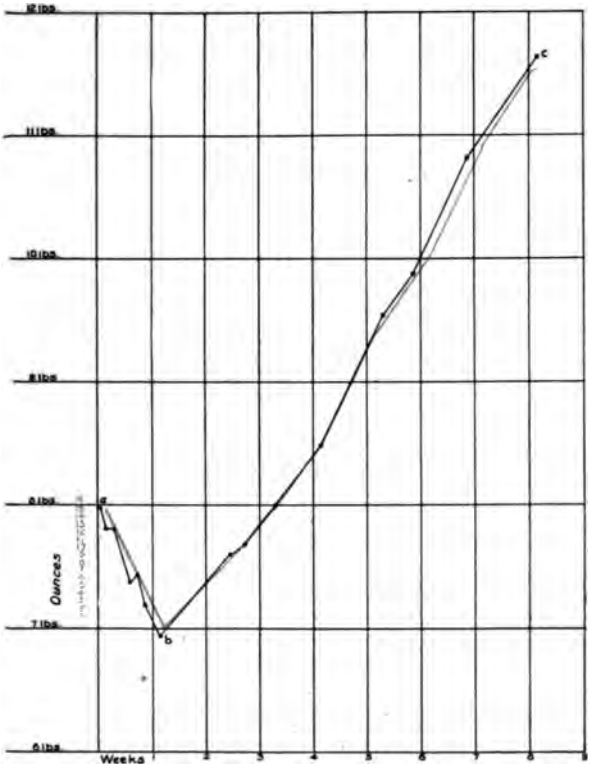
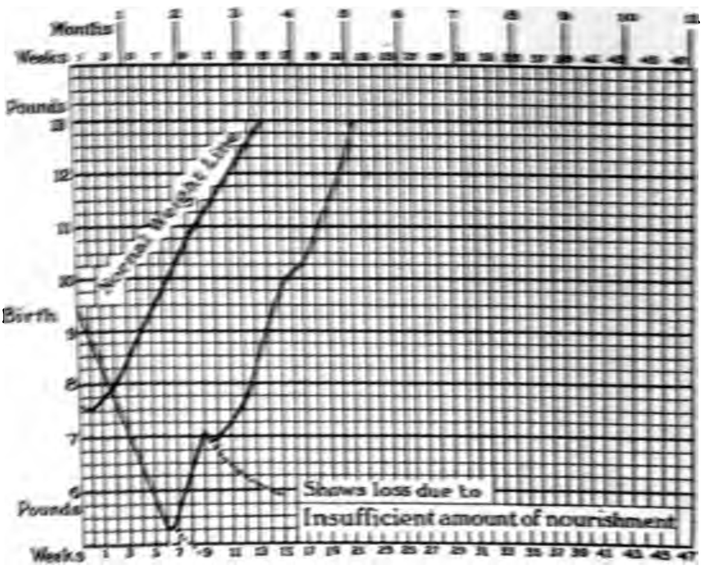



Fig. 49.—Weight curve in a case of complete or surgical pyloric obstruction. *a-b*, continuously downward course (characteristic of this type of obstruction), resembling the crisis of pneumonia temperature curve; *b-c*, upward course (gain) after posterior gastroenterostomy. (Original case. Operation by John B. Deaver, M.D.)

modified cows' milk or upon a patented food without any relief from the vomiting. Such a history, obtained in a breast-fed baby, should always create the suspicion of

pyloric obstruction. In my experience it has been so constant that I have come to regard it almost as a part of the clinical picture of the disease.

*Constipation.*—Think again of the pylorus completely occluded either from spasm, hypertrophy, or both. All the




**Loss of Weight during period of observation for four days just preceding operation**

Fig. 50 shows effect of posterior gastroenterostomy on weight curve in a case of complete pyloric obstruction. Note continuously downward course of weight curve before operation, as in Fig. 49. Original case. Operation by Francis T. Stewart, M.D. (H. Lowenburg, N. Y. Medical Journal, February 11, 1911.)

food is vomited. None passes into the duodenum and hence into the intestines. The reason for constipation is clear. It is *complete—absolute*. It is ***obstipation***. The bowels move rarely, it is true. The movements consist of a discharge of bile-stained mucus. They have no bulk. They

contain ***neither curds nor digested-milk feces,*** because none can come through.

*Weight and Strength.*—From the very onset of symptoms the weight curve tends progressively downward. It is

Fig. 51.—Visible gastric peristalsis.

continuously depressed. There is no hesitation, no retrenchment, no stationary weight. The loss may not be suddenly great. It is rarely so. It is, however, ***continuously downward.*** Thus an infant weighing 7½ pounds at birth, for instance, may lose ½ or ¾ pound by the end of the first week after the onset of symptoms. If this is repeated dur-

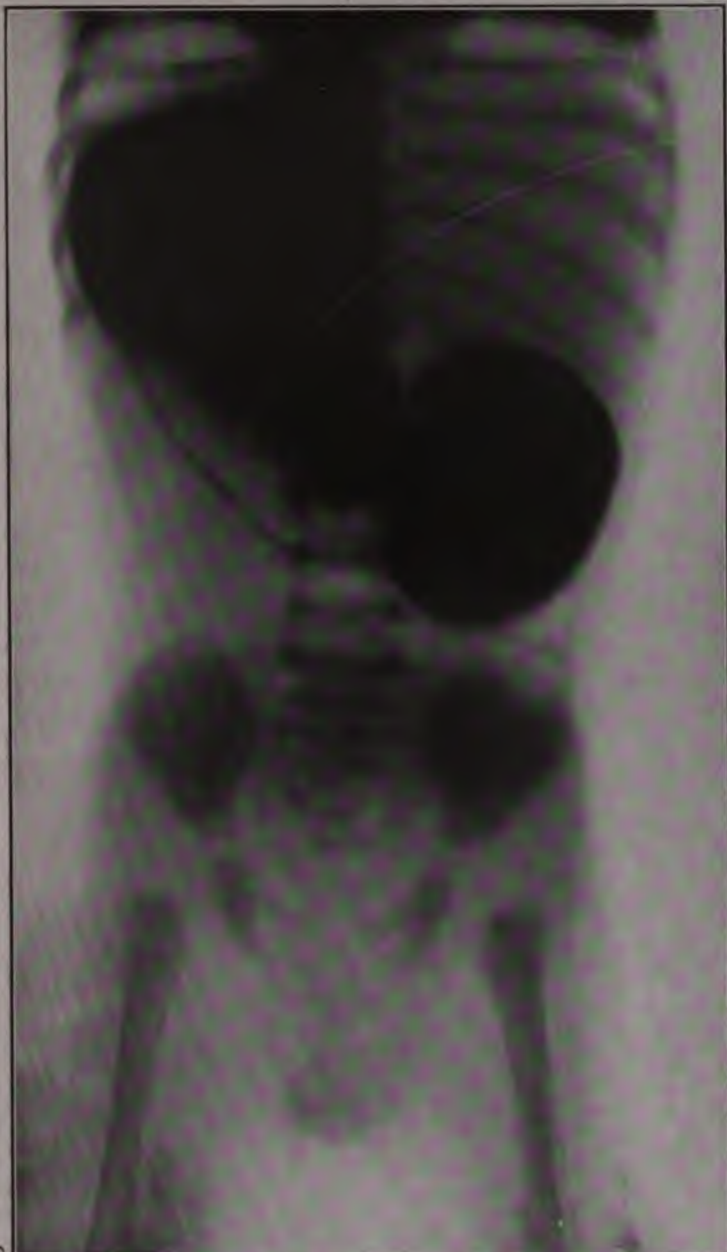
ing the second and third week, the possibility of complete obstruction or practically complete obstruction becomes a certainty. The weight curve in these cases resembles in a sense the *curve seen in the crisis of pneumonia* (Figs. 49 and 50; compare with Figs. 52 and 53). The effect of edema on the weight curve will be considered later.

The *infant's strength* for obvious reasons becomes progressively less. Its movements become weak; its cry lacks force and it lies quietly in bed unless disturbed.

*Visible Gastric Peristalsis* (Fig. 51).—This is the most interesting as well as the most important symptom from a diagnostic viewpoint. Bearing in mind again the obstruction at the pylorus (Fig. 48), its method of production is readily understood. The stomach endeavors, as it were, to pass its contents onward into the duodenum. It cannot do so. This causes the peristalsis of the stomach to become exaggerated. The involuntary muscle is stimulated in an effort to overcome the obstruction. The waves of contraction become greater and are seen in the epigastrium, passing from left to right. A globular mass which can be palpated will appear under the lower left costal margin. It will lazily pass across the epigastrium. Before it progresses very far another will form at the original site and slowly follows the first, which gradually disappears under the right costal arch, while perhaps yet a third is forming under the left border. So it will be seen that two or three globular masses are slowly following one another from *left to right* across the epigastrium. The appearance has been likened to the rolling of two or three balls under the skin. The masses represent sections of the contracting stomach.

The gastric peristalsis is not constantly visible. In the beginning it may not be seen at all because emaciation has

PLATE XIV

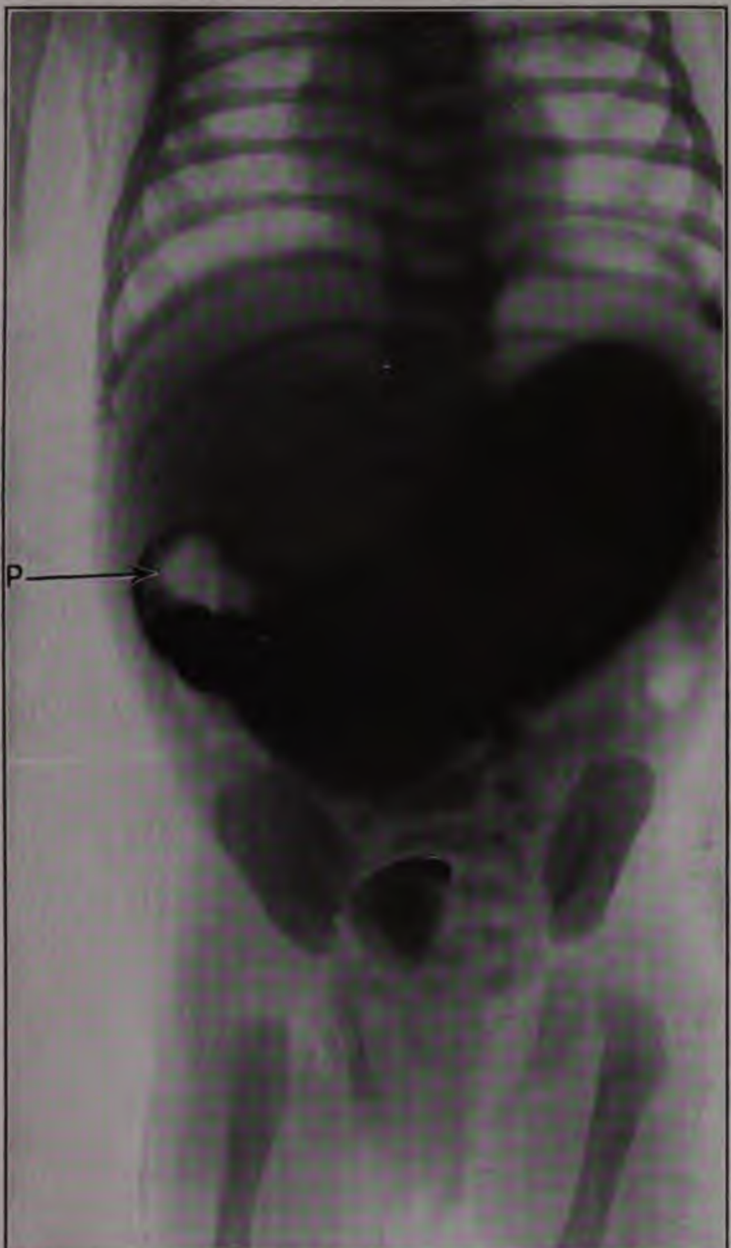


Practically complete obstruction. Operation. Recovery. Immediately after the administration of the bismuth.

PLATE XV

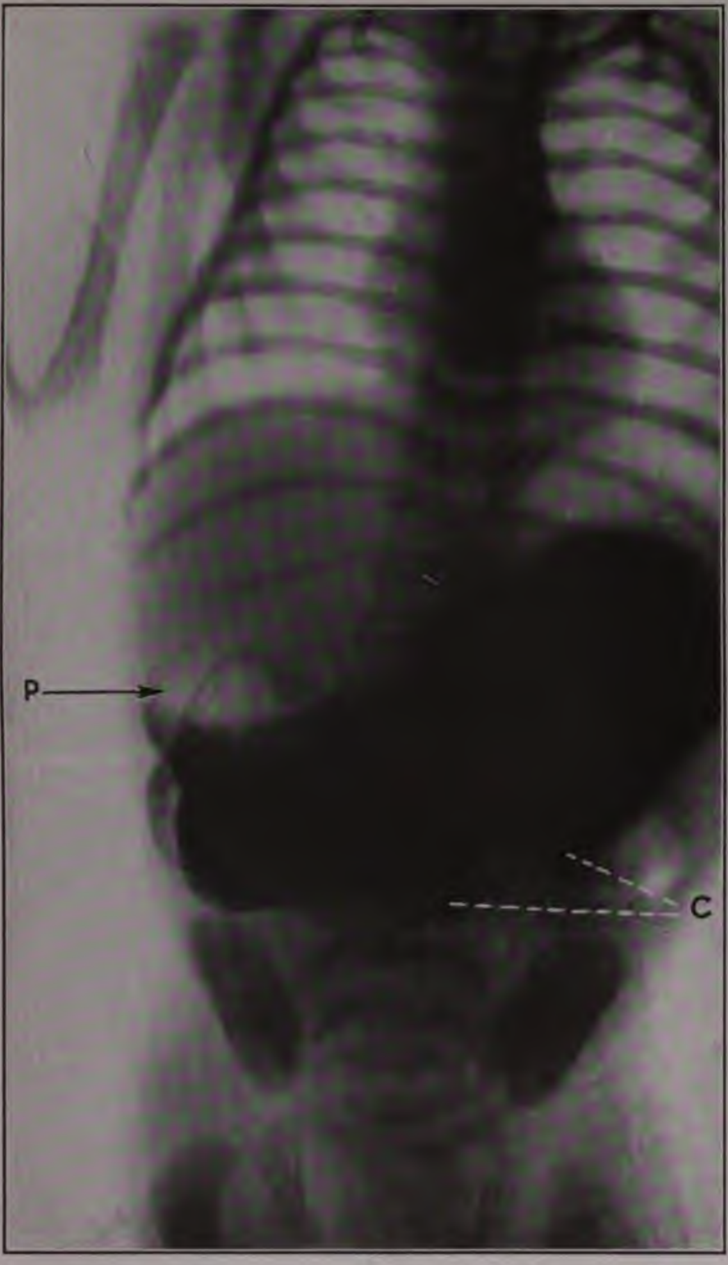
One hour after the administration of the bismuth. None of the chemical has left the stomach.

PLATE XVI




Three hours later. No bismuth has left the stomach. Note the thickened pylorus ($P$) and how the bismuth shadow stops abruptly there.

PLATE XVII

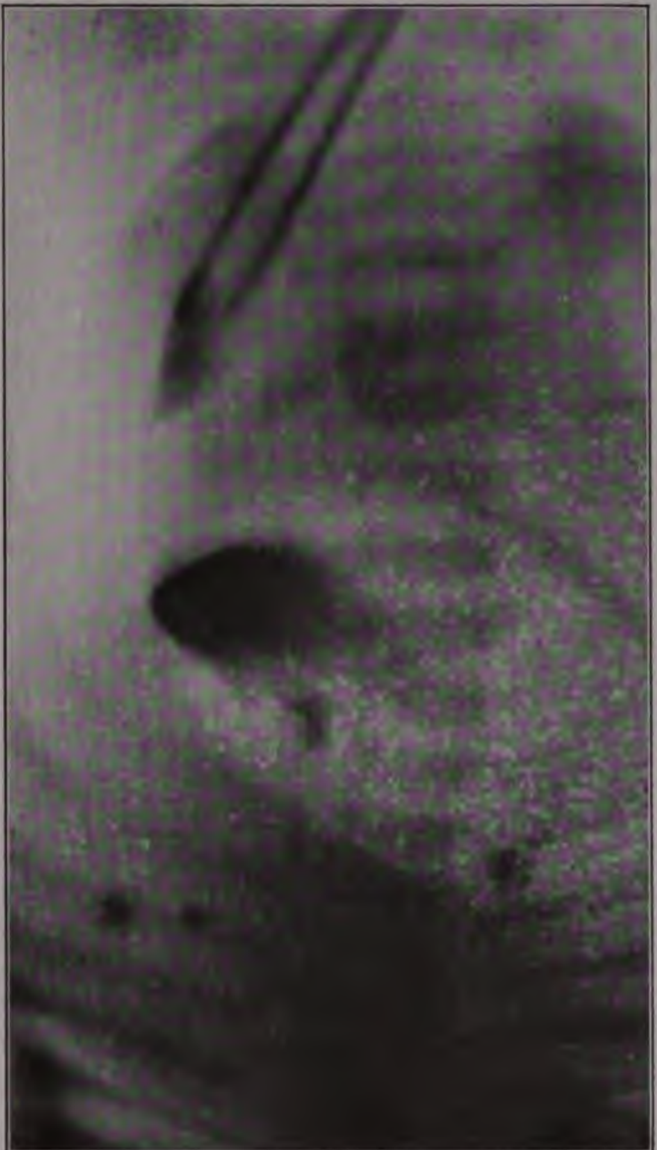



Six hours later. No bismuth has left the stomach. Note the stomach was photographed while undergoing contraction ($C$). Note the lower border of the stomach to be opposite the brim of the pelvis. No bismuth has passed beyond the thickened pylorus ($P$).

PLATE XVIII

The next day, about nineteen hours later. Bismuth still in the stomach. Very little in the small intestines and sigmoid. The amount is practically negligible. Infant has vomited some of the bismuth.

PLATE XIX



Comet-like appearance of the bismuth shadow at the pylorus in cases of complete obstruction. This appearance is almost constant and is very characteristic of this type of obstruction.

not become sufficiently advanced to permit the movement to alter the normal appearance of the surface of the upper abdomen. It may also be invisible when the stomach is empty, as immediately following a severe spell of vomiting. Just preceding this event, however, it is commonly accentuated. It is often present during sleep. *It may be inaugurated by the giving of food or drink or by tapping lightly upon the epigastrium with the back of the middle-finger.* A few moments may elapse before the contractions commence to appear. *Therefore, when searching for this symptom it is unsafe to conclude that it is absent unless the maneuvers above are employed and unless the epigastric area be visualized at least for from ten to fifteen minutes.*

In some cases the pain associated with the contractions is so intense as to cause the infant to cry.

Rarely the movement of the visible gastric peristalsis is seen to be *reversed, i.e.,* it passes from right to left. All these instances, however, must be carefully distinguished from visible peristalsis due to contraction of the transverse colon. This is occasionally met in thin subjects and in cases of obstinate constipation or of organic obstruction of the large intestines.

*Dilated Stomach.*—At first the muscle-fibres undergo hypertrophy. Later they become thinned and the degree of gastric dilation may become enormous (Plate XIII). As a rule the lower border of the stomach may be readily seen through the thin abdominal wall. At first it does not reach below the umbilicus, and the upper abdomen alone is distended while the lower portion of the belly is flat on account of the collapsed condition of the intestines, into which no food has entered. Later as the dilation increases the lower border of the stomach reaches far below the navel. In fact

it may reach the pelvic brim (Plate XIII). This is readily determined by inspection and can be confirmed by palpation and X-ray studies. In this enormous degree of gastric dilation is found the explanation why, in advanced cases especially, vomiting need not and does not occur after each feeding and may appear but a few times each day.

*Palpable Pylorus.*—The pylorus is thick and hard (Fig. 48); whether from hypertrophy or from spasm or both, matters not. The abdominal wall is thin. Therefore *it is possible to palpate the pylorus.* It is commonly felt as a hard object, about the size of a small olive, a little above and to the right of the umbilicus. It is best felt by placing the warm hand gently upon the abdomen, employing the middle-finger as a searcher by gently but firmly pressing it into the abdominal wall. If the abdominal muscles are made rigid by crying or straining, palpation cannot be successfully accomplished. In order to overcome this the examination should be made while the infant is placed at the breast, or while it is receiving other food or drink, or sometimes during sleep. The abdominal wall must be thoroughly relaxed.

In some cases of complete obstruction it is impossible to palpate the pylorus during the early stages of the case on account of the comparatively thick layer of adipose tissue, only slight or no loss of weight having occurred. The position of the pylorus is not always constant. It is occasionally found close to the lower border of the liver, near the median line, but above the umbilicus. Where a great amount of gastric dilation has ensued it may be found low down and close to the pelvic brim to the right of the median line.

*X-ray Studies.*—These should be made in all cases. *While unnecessary for a clinical diagnosis of obstruction, per se, they aid materially in distinguishing complete from incomplete cases, and are often of value in assisting to determine whether the treatment shall be surgical or non-surgical.* For making these studies only *bismuth subcarbonate* should be employed, and should be administered through a tube. In cases of complete obstruction it will be found that no bismuth leaves the stomach to enter the intestines, after a period of twenty-four hours. During this time a series of no less than eight or ten exposures should be made, commencing immediately after the administration of the drug and ending not less, in any case, than sixteen hours after this time. This will insure sufficient time to permit the smallest amount of bismuth to pass (Plates XIV, XV, XVI, XVII, and XVIII).

In cases of complete obstruction I have noticed that the bismuth shadow assumes a "comet"-like appearance almost immediately after administration. I regard this as highly significant (Plate XIX) of this type of obstruction.

*Charcoal Test.*—Administer 10 grains of either animal or wood charcoal through the stomach-tube, to the near end of which is attached a syringe which contains the charcoal suspended in an ounce or two of water. Slowly inject it. Make a note of the hour of injection. Have the nurse do the same, each time she changes a soiled diaper. *In cases of complete obstruction no charcoal will appear upon the diaper.* In the mean time considerable charcoal will be lost each time the infant vomits. At the end of twenty-four hours wash out the stomach. *The washings will contain charcoal*—showing conclusively gastric retention and the non-entrance of aliment into the intestinal canal.

*Temperature.*—This speedily becomes *subnormal* unless external heat is employed. If infection occur it becomes elevated. These infants become readily infected (see Complications). When starvation becomes marked the temperature rises and may reach 104° F. before death. I have also witnessed a sudden rise which I cannot explain follow immediately after stomach washing. It speedily disappears, however. The poor resistance of these babies is frequently emphasized by their death from pneumonia just about at the end of the disease or immediately after recovery. The temperature rises very high and death may ensue before the signs of consolidation become evident.

*Urine.*—The urine exhibits no changes of interest except toward the end in cases which have remained untreated and in which vomiting has been unduly severe. The tissues become parched for the want of water. The urine then is scant, dark, highly concentrated, sharply acid, and excoriating. Urates may be deposited upon the diaper. A faint trace of albumin is present and microscopically kidney *débris* and other organized substances are found. Therefore, other things being equal, it may be correctly surmised that a free flow of normal limpid urine is a favorable sign.

*Edema.*—This is not directly a part of the clinical picture of pyloric obstruction. It may, perhaps, be better classified as a complication. It is emphasized here, however, because its onset is so insidious and because it frequently passes unnoticed, but *principally because it is responsible for a more or less abrupt increase in weight which is erroneously regarded as a favorable sign.* The additional weight is not fat, but water. I have seen this error made and a favorable prognosis recorded when death

was but a few days away. *It is a very unfavorable symptom.* It occurs along toward the end of severe cases in which vomiting has been unusually constant. The insteps and the lower legs are first affected and gradually it spreads upward, rarely, however, passing above the knees. Its method of production is little understood, notwithstanding an overabundance of theorizing.

**B. Incomplete Obstruction.**—This type is more common than that of complete obstruction. There are, however, all grades of this form which clinically must be differentiated. Many of them approach in severity cases of complete obstruction, as we shall see, and must, like them, be treated surgically. Therefore, the distinction between complete and incomplete obstruction must not be regarded as final, but, therapeutically, at least, the classification of *surgical* and of *non-surgical* must be made as well, for many cases of incomplete obstruction require operation. In fact, I believe the number of this type of case is daily increasing, as the mortality from operations is steadily becoming less and as the cases are receiving closer clinical study.

*Vomiting.*—This partakes of the nature of the vomiting in cases of complete obstruction, except in very mild instances wherein the spasm occurs with some intermittency. Here the intervals between attacks may at times be more than a day or two, to be renewed again with intense vigor, when the degree of spasm increases.

*Constipation.*—Bearing in mind again the obstruction at the pylorus and that it is not complete, one can readily understand that some of the aliment passes and that therefore constipation, while present, is not absolute. *The size and the frequency of the movements vary directly as the degree of obstruction, which also determines the severity of*

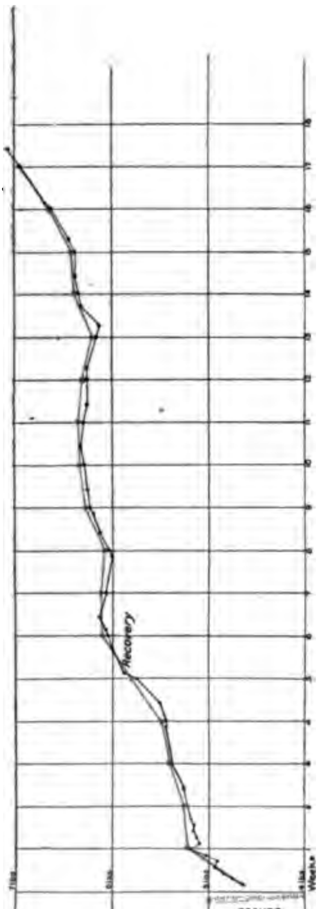



Fig. 52

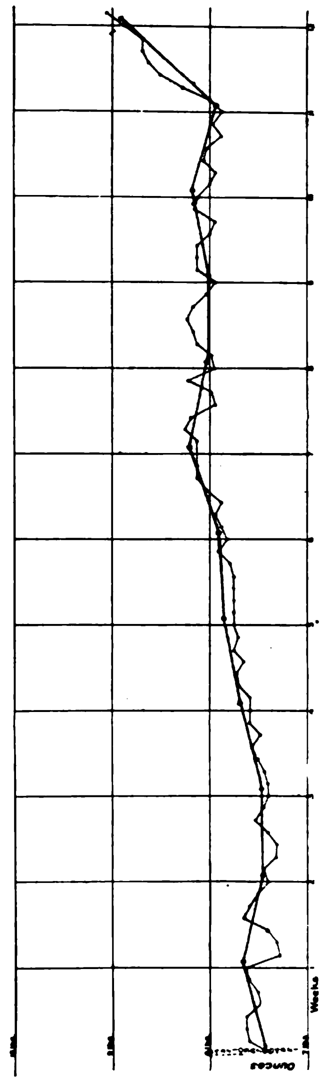



Fig. 53

Weight charts of two cases of incomplete non-surgical pyloric obstruction. Fig. 52 is less severe and the gain in weight, while gradual, is more rapid than in Fig. 53. Fig. 53 shows the characteristic weight curve obtained in cases of incomplete non-surgical cases. The line resembles that seen in the temperature curve of the fastigium of typhoid or other continued fever. The weight remains stationary for weeks, slight losses and gains being alternately recorded, the gradual course, however, being upward. After the eleventh week there was a sudden gain of several ounces, which was maintained.

*the two symptoms—vomiting* and *wasting*. These, in common with *constipation*, form a trinity of symptoms which are closely interrelated, and which possess considerable prognostic import. The movements are usually small and dry. Not being of sufficient size to stimulate peristalsis, they lie in the lower bowel so long that they become inspissated. The bowels move, on the average, once every three or four days, a suppository or the clinical thermometer being necessary to secure an evacuation. The movements consist of *milk feces* and *mucus*, and often contain small *curds* which in themselves are conclusive evidence that the pylorus is not entirely occluded.

*Weight and Strength*.—A common clinical type of incomplete obstruction presents a weight curve which is radically different from that of complete obstruction. For developing this fact, I believe that I may claim originality, for I have no knowledge of its description having been proposed by any other author. Before describing this curve it is necessary to state that there is one type of case, however, of incomplete obstruction of which this is not true, viz., those instances in which the passage through the pylorus is so small that but little aliment passes, and for all intents and purposes, clinically at least, the case presents the features of complete obstruction, and must be so regarded therapeutically. It would perhaps be better to say that this latter type of weight curve belongs to *surgical cases* rather than to a certain type of incomplete obstruction, because all cases which present it must be operated upon and under it are included as well all cases of complete obstruction, as has been already indicated (Figs. 49 and 50). Figs. 54 and 55 represent the correct manner of weighing an infant.

The curve in typical, non-operative, or non-surgical

incomplete cases suggests the *line of a continuous fever with slight remissions and elevations* (Fig. 53; compare with Figs. 49 and 50). Thus the infant loses a few ounces,—say, two or three. The next day he gains one or two ounces. The day following neither loss nor gain is recorded. This may continue for a day or two. Again a slight gain or a slight loss occurs, so that at the

Fig. 54.—Weighing the baby. First ascertain the weight of the towel. (Fairbank's scale, No. 554.)

end of a week the weight is the same or there is noted the loss or the gain of an ounce or two. The curve may remain stationary for two or three weeks, with slight losses or gains recorded in the daily estimations. These have a direct relation to the severity of the vomiting and the constipation. If spasm is worse for a few days, these are increased and with them is recorded a loss. As the obstruction relaxes vomiting and constipation are less, and the lost weight is partially or wholly regained, with an ounce or so to spare. Therefore it can be appreciated how at the

end of five or seven weeks after birth the weight has changed but little, being somewhere between six and seven pounds, or there may be noted but a slight loss of about a half to three-quarters of a pound. A careful study of Figs. 50 and 53 will be of value in emphasizing this crucial clinical point of difference between operative and non-operative cases.

Fig. 55.—From combined weight of baby and towel subtract the weight of towel to obtain result.

*Visible Gastric Peristalsis.*—The description of this symptom under complete obstruction applies here, except that at times the intensity of the waves may be temporarily suspended only to return again with increased vigor.

*Dilated Stomach.*—The degree of dilation is somewhat less than in complete cases, although in severe types it may reach to enormous proportions. After recovery, in non-operative cases too, the normal outlines of the stomach are commonly recovered except in those cases which extend into childhood and to which reference will again be made.

*Palpable Pylorus.*—The same causes which at times interfere with the successful palpation of a completely occluded pylorus apply here. In addition, in those cases which depend entirely upon spasm and in which this phenomenon is intermittent, even when the abdominal wall is quite thin, the pylorus will not be palpable when it is relaxed. Therefore should this finding be reported negatively it does not exclude the diagnosis of either pyloric obstruction, complete or incomplete. In the latter instance it may be positive the next day or within a few hours or even minutes. It may occur as the visible gastric peristalsis, directly after the giving of food or drink or after tapping over the epigastrium, to disappear again. *The feel of a pylorus in spasm is just as hard as of one thickened by hypertrophy, only it may not be so constant.* For this reason I do not believe, as some authors teach, that every case in which the pylorus is palpable should be operated upon. I have had several non-surgical recoveries in such instances. This intermittency is very common in partial cases and is suggestively diagnostic of them. Where hypertrophy is present or where spasm is intense and permanent, this intermittency of palpability may be absent and the hard, olive-like pylorus may be easily and constantly felt.

*X-ray Studies.*—These indicate that more or less rapidly, depending upon the degree of obstruction, varying amounts of bismuth pass from the stomach into the intestines. The quantity which does pass and the time occupied furnish valuable data in assisting to determine the necessity for or against operation (Plates XX, XXI, XXII, XXIII, XXIV, XXV, XXVI, XXVII, XXVIII, and XXIX). A careful study of these plates will indicate that cases of *in-*

*complete obstruction* may be either *surgical* (Plates XXV to XXIX) or *non-surgical* (Plates XX to XXIV).

*Charcoal Test.*—Charcoal passes through the pylorus and *is* therefore *found in the feces.* The stomach washings contain *not any, little,* or *much charcoal,* twenty-four hours after administration, depending upon the degree of obstruction and the severity of the vomiting. Immediately after administration the caretaker is instructed to save and mark the time of each soiled diaper. In this way an idea is obtained as to the degree of obstruction and the rapidity of the peristalsis. Therefore the X-ray findings and the charcoal test are valuable in permitting of an intelligent separation of the surgical from the non-surgical cases.

*Temperature.*—Where the degree of emaciation is extreme, the temperature is subnormal. However, it is less difficult to maintain a rectal temperature of $98^2/_5°$ to $99°$ F. than it is in complete cases.

*Urine and Edema.*—Neither of these possesses the same interest as in cases of complete obstruction unless the degree of impatency be unusually severe.

## DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS.

**A. In General.**—Pyloric obstruction is not recognized because the average physician does not include it in the range of possibilities in reference to every case of wasting with which he comes in contact. He does not think of it at all. Its clinical features are so unique that it cannot be mistaken for anything else and cannot be passed by if it is at all considered. Nearly every case of unrecognized pyloric obstruction which I have seen in consultation has been called *marasmus.* The differentiation has already been discussed under the description of the latter (Chapter IV,

page 165). It is of sufficient importance, however, to emphasize here that these two conditions resemble each other only in so far that in both wasting is a prominent feature. *Wasting in infancy, however, must simply be regarded as a symptom and not as a disease, and the underlying cause must always be diligently sought. In this connection pyloric obstruction must always be considered as a very potent and probable factor of the nutritional bankruptcy.*

A very common occurrence is to consider that the *vomiting is due to the breast milk. The infant is then promptly removed from it and a medley of formulas and patented foods are employed before the real cause of the disturbance is discovered.* The practical constancy of this error, as forming a part of the clinical history of this disease, has already been considered. For ordinary purposes it may be stated *that mother's milk never causes vomiting,* per se, *unless the amount of fat is unusually high for the individual.* More often among benign causes of vomiting in the suckling it will be found that too frequent feeding, prolonged nursing, nervous influences, improper training, and bad hygiene, singly or combined, are operative. Besides, the character of the vomiting is never propulsive. Therefore the following may be stated as a truism: *That every case of persistent vomiting, especially if projectile, occurring in a breast-fed baby, must be regarded as due to obstructive pyloric disease until it can be proven that it is not.*

The only other factor responsible for projectile vomiting is *cerebral disturbance.* Here a history of dystocia or forceps pressure or visible head trauma will be in evidence, together with the results of cerebral pressure or irritation, as coma, palsies, or convulsions. An exception to the last occurred in a case seen at the Mt. Sinai Hospital, in which,

following a history of forceps delivery, the infant suffered one or two attacks of convulsions. Vomiting soon supervened, but a careful physical examination revealed all the characteristics of pyloric obstruction incomplete. This merely emphasizes the need of bearing pyloric obstruction in mind in every case of vomiting as well as in every case of wasting.

*Cyclic Vomiting.*—I have proven to my own satisfaction, at least in one case in which the diagnosis of cyclic vomiting had been made, that the cause of the periodic emesis depended upon the persistence of a mild intermittent pyloric obstruction. The child was 2½ years of age. The history of incomplete pyloric obstruction in infancy was clear and X-ray studies, as well as the retarded passage of charcoal, made the diagnosis certain. Therefore, the suggestion is offered that all cases of so-called cyclic vomiting in young children should be studied from this standpoint before they are regarded as being idiopathic, reflex, or metabolic. The case to which reference has been made recovered completely under lavage.

*Obstipation or constipation,* occurring as the result of congenital or other defects, may cause some confusion, especially if there be associated *reflex* vomiting, so called. Bearing in mind the essential symptomatology of pyloric disease, an intelligent discrimination will readily be permitted.

**B. Complete Obstruction.**—Depending directly upon the complete obstruction at the pylorus, the following ensemble of symptoms constitutes a definite clinical picture: *Propulsive vomiting, obstipation, loss of weight and strength (persistent), visible gastric peristalsis, dilated stomach, palpable pylorus; non-passage of bismuth subcarbonate from*

*the stomach into the intestines, as shown by the X-rays; the non-passage of charcoal through the gastrointestinal canal and its recovery the next day in the stomach washings.*

**C. Incomplete Obstruction.**—This is characterized by *propulsive vomiting; a variable degree of constipation; a gradual loss in weight, which may become stationary; visible gastric peristaltic waves of variable intensity; permanently or intermittently palpable pylorus; dilated stomach; the retarded but final passage of bismuth through the pylorus into the intestines; the passage of charcoal and its non-return or in variable but small amounts in the gastric washings, depending upon the degree of obstruction.*

By noting the amount of bismuth and of charcoal which passes, one is often permitted to judge of the quantity of aliment which gets through, and is therefore able to conclude roughly whether this is sufficient to sustain life. This materially assists one to properly catalogue the individual case as surgical or non-surgical. The differential data between these two types of cases are systematically presented under the prognosis, page 338.

## COMPLICATIONS.

*Pneumonia* may occur, rarely, as a direct result of stomach washing, due to inspiration of foreign material. These cases all do poorly. *High temperature,* difficult to explain, may follow stomach washing. As has been mentioned, it speedily disappears. *Edema* has been noted. These infants, on account of their low vitality, bear infection badly. I have seen a severe case of *pyemia* follow the undoubted infection of *bromid papules.* The eruption was profuse upon the scalp and face. Under the administration of a mixed streptococcic and staphylococcic serobacterin recovery

ensued. *Sudden death* occurs without apparent cause, as in cases of marasmus, after extreme emaciation has persisted for some time.

## PROGNOSIS.

In general this depends upon the promptness with which a diagnosis is made, and with which an intelligent therapy is adopted and conscientiously pursued. No half-way measures will bring results. Cases which are hawked from doctor to doctor or from clinic to clinic eventually succumb. For this reason I believe that, once the diagnosis is made, the physician should make a frank statement of the case to the parents, going into details as to the exact nature of the trouble, defining his attitude, telling them at best the case will be long drawn out, and that at any time, after a sufficient period of observation has elapsed, it may become operative. On this point, I believe that a week's observation should permit of an intelligent and final opinion.

The attention to details, the infant's environment, close adherence to prescribed methods of treatment, strict loyalty to feeding orders, are all of unquestioned importance in their bearing upon the final outcome of the case.

Of course, operation increases the immediate danger. However, the results after posterior gastroenterostomy have been so excellent that in selected cases it should not be too long postponed. The operation must, however, be done by an expert, and before the infant's nutrition and strength become too seriously impaired. Even as a *dernier ressort* it must not be refused, in cases which have been neglected. No case is hopeless, from an operative standpoint, until it is dead. Scudder and others report brilliant success from operations. My own operative cases include six: one, almost moribund, recovered after operation by Dr. Francis

T. Stewart. Five others were operated upon by Dr. John B. Deaver: four made excellent recoveries; one died twenty-four hours after operation. This infant was edematous and emaciated when brought to the table, where it nearly succumbed twice during operation. Operation had been advised as the only hope two weeks previously, but was refused. The youngest case operated upon by Deaver was 3 weeks of age. It made a perfect recovery. The oldest, operated upon by him for me, was 8 weeks of age. It too became well. Sixty-three per cent. of my medical cases recovered. Of those which died some were unrecognized until it was too late, some refused surgical treatment, and still others were entirely neglected. I believe that if the cases treated medically are properly selected, the percentage of recoveries would be higher and would equal at least the operative results. The idea which I wish to convey is that in our study of this disease it should ever be our aim to improve our knowledge as to the character of a non-operative and of an operative case. The line of distinction can be drawn, and I believe that none of these babies, if properly classified, other things being equal, need succumb. *Even recognizing that operation increases the immediate danger, I believe that this risk should be assumed in more cases rather than to err on the side of attempting to treat surgical cases by non-surgical methods.* It is my belief that the general mortality of pyloric obstruction would in this way be more materially reduced than if more conservative methods were pursued.

**What constitutes a surgical case? What constitutes a non-surgical case?** *Clinically all cases become operative when sufficient aliment fails to reach the intestines.* Therefore it follows that not only are all cases of complete ob-

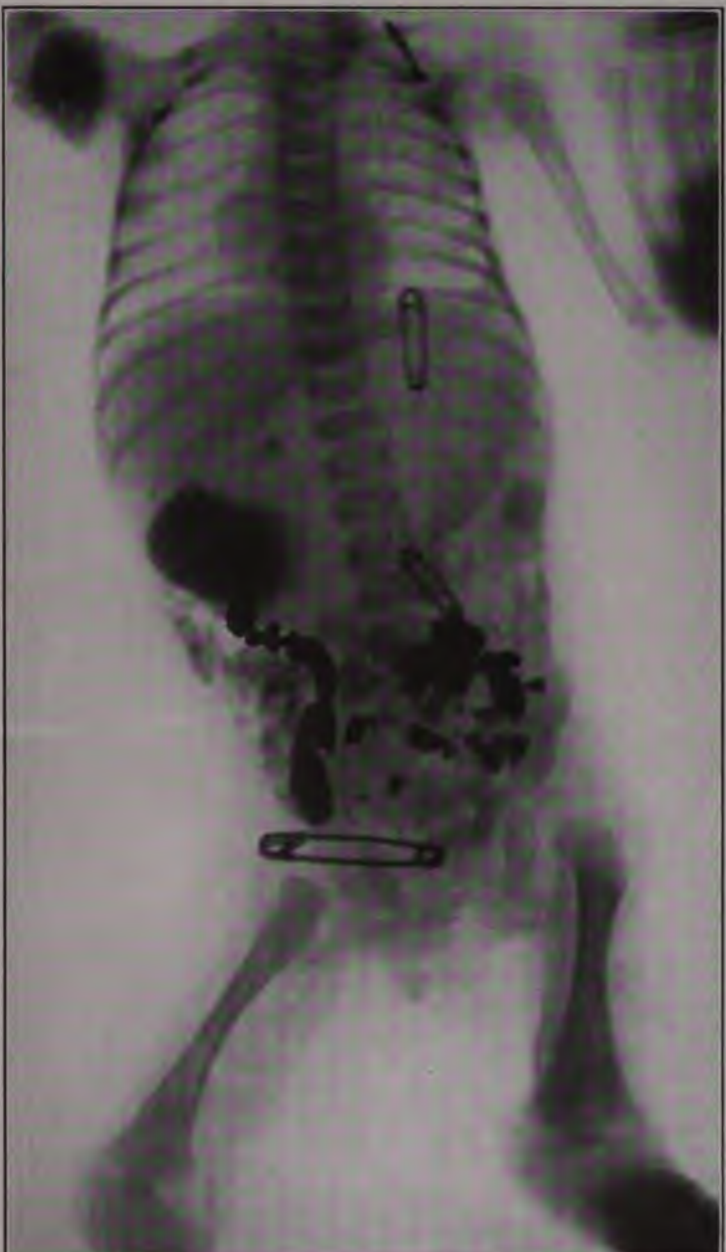
PLATE XX

Non-surgical incomplete pyloric obstruction. Bismuth in the stomach immediately after administration.

PLATE XXI

Two hours later. Much bismuth is seen in the small intestine, but also in the stomach.

PLATE XXII

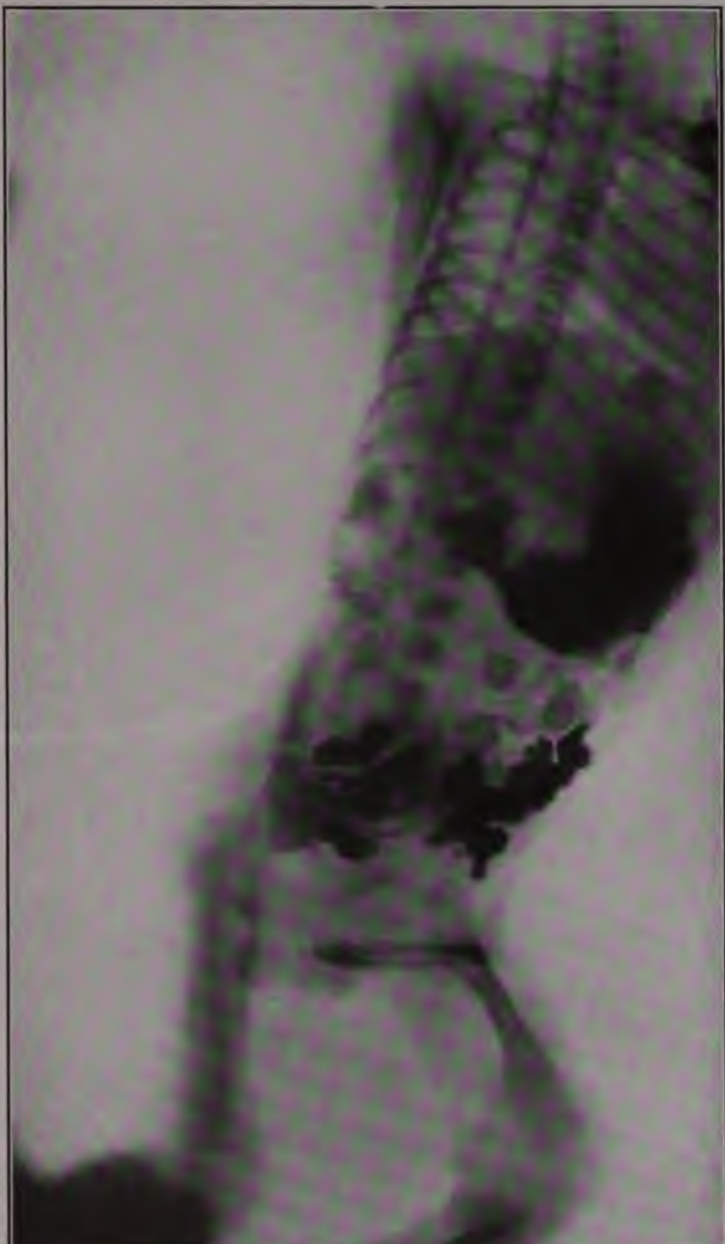


Bismuth still in stomach, but also seen in small intestine and in the ascending colon; four hours after administration.

PLATE XXIII

Much bismuth still in stomach, but also seen in the descending colon and sigmoid; six hours after administration. Stomach should be empty.

PLATE XXIV



Eighteen hours later. Stomach should be empty, but still contains much bismuth.

PLATE XXV

Case of incomplete but surgical pyloric obstruction. Gas and bismuth in contracting stomach, immediately after administration.

PLATE XXVI

Bismuth in stomach, but small amounts scattered throughout small intestine; two hours later.

PLATE XXVII

Same as Plate XXV, four hours after administration.

PLATE XXVIII

Eight hours after administration of bismuth. Stomach still full and very little bismuth has reached colon.

PLATE XXIX

Sixteen hours after administration. Stomach full. Still much bismuth in stomach and very little in large intestine. It can readily be seen that if this represents the amount of food which passes, starvation must follow. Compare Plates XXV to XXIX inclusive with Plates XX to XXIV inclusive.

struction to be treated surgically, but also those incomplete cases in which the degree of obstruction is so great and so persistent that for all intents and purposes they may be regarded as complete. In these cases the amount of bismuth which passes through, representing really the same amount of food, is negligible and certainly is not sufficient to maintain tissue balance, let alone to provide for growth as well (Plates XXV to XXIX). Therefore, in deciding the issue, the character of the weight chart is of prime importance. My study of many cases convinces me that all operative cases will show a weight curve represented by Fig. 50, and that all non-operative cases, charts like Figs. 52 and 53. The further elucidation of this important point is assisted by a careful study of the X-ray's findings, the charcoal test, and the degree of constipation. *It is important to emphasize that the distinction between surgical and non-surgical cases must be made upon clinical findings alone, and not on the cause of the obstruction, even were this always determinable.* It is perfectly conceivable that simple spasm may be so intense and so persistent as to entirely occlude the pyloric orifice, while, on the other hand, hypertrophy may occur without causing even as much encroachment upon the lumen. In order to facilitate an early distinction the differential table on next page is submitted.

## TREATMENT.

At present this is either *surgical* or *non-surgical*. No preventive methods are known.

Surgical.—I shall not discuss the surgical treatment from the standpoint of technique. This has been ably done by Dr. John B. Deaver. The province of the physician, I believe, is to determine whether or not operation should be

## Differential Table.

| NON-SURGICAL. | SURGICAL. |
|---|---|
| 1. Weight curve resembles *curve of continued fever with slight remissions and elevations.* At end of week it is stationary or but slight loss or gain is recorded. | 1. Weight curve resembles the *crisis of a pneumonia.* End of a week records a loss of 8 to 10 ounces or more. |
| 2. General strength not materially reduced at end of this time. | 2. General strength fails rapidly. |
| 3. Bowels constipated, but of fair size, and movements contain curds or digested milk. | 3. Constipation absolute or nearly so. Milk feces may be passed, but only in very small amounts. Movement ordinarily consists of bile-stained mucus. |
| 4. Recovery of considerable quantity of charcoal in anal discharges, although its passage is delayed. | 4. Non-recovery of charcoal in anal discharges, or very little, and this appears first thirty-six to forty-eight hours later, and continues for many days. |
| 5. Non-recovery or recovery of but little charcoal in the stomach washings twenty-four hours later. | 5. Recovery of considerable quantity of charcoal in the stomach washings twenty-four hours or more after administration. |
| 6. X-ray examination confirmatory of charcoal findings and character of the constipation. Reveals more or less bismuth in the small and large intestines. | 6. X-ray pictures taken in series for a period of twenty-four hours show retention of bismuth within the stomach, and not any or only traces in the small and large intestines. Bismuth shadow has a "comet-like" appearance. |
| 7. Severity of vomiting is intermittent and often yields to gastric lavage. | 7. Constant. Not influenced by gastric lavage. |
| 8. Pylorus non-palpable or intermittently so. | 8. Constantly palpable except before emaciation occurs. |
| 9. Intelligent and individual care of the infant at home may delay or permanently eliminate the necessity for operation even in severe cases. | 9. Nearly all hospital cases and those in which the environmental influences are bad should be operated upon irrespective of the degree of obstruction. |

done. This must not be left to the surgeon alone, who, as a rule, has little patience with less rapid methods and certainly can have had but little experience in handling nonsurgical cases. It is hoped that the foregoing discussion will materially assist the medical attendant to reach a safe conclusion. The surgeon must decide the choice of operation. In all of my cases posterior gastrojejunostomy was performed. The results have been so satisfactory that I prefer it. I believe this to be the operation of preference with most surgeons. Divulsion has been recommended, but it seems uncertain. Simple incision of the pylorus along its longitudinal axis through the peritoneum and muscle, *down to* but *not through the mucosa,* has been practised with immediate good results. No sutures are taken in the pylorus. The circular fibres are thus severed. The lumen of the pylorus becomes patulous. The abdomen is immediately closed and the wound in the pylorus is allowed to heal by granulation. What the subsequent life of such an individual would be, is uncertain. The old scar may cause considerable trouble through further contraction, although theoretically it should not. This operation was devised by Ramstedt and is recommended by E. Feer (Zürich). A case successfully treated in this manner is reported from Koplik's clinic in the *New York Medical Journal.* As noted below, Dr. Deaver does not recommend this operation.

What is the subsequent course of cases operated upon by gastroenterostomy? This is a matter of pertinent interest. Does the pylorus become patulous? Does the artificial opening enlarge and continue to functionate properly throughout adult life? Does food leave the stomach via both the artificial and the natural routes? These questions are difficult to determine accurately. I believe

that the cause of the obstruction plays an important part as to whether the pylorus subsequently becomes patulous or not. Where spasm overshadows the amount of hypertrophy, in all probability food will again pass through the pylorus. Where hypertrophy is the main factor, permanent occlusion is most likely. In all the cases which I have been permitted to study with the X-ray, after operation, the artificial opening alone was functionating and the pylorus was still impervious. The oldest child thus studied was 3½ years of age. In discussing this point with pediatrists and surgeons, it appears that the concensus of opinion is that this represents the usual course of events. Further skiagraphic and post-mortem studies are necessary to determine this with accuracy. Fig. 49 represents the effect of a successful gastroenterostomy upon the weight curve of a case of complete pyloric obstruction.

**Postoperative Treatment.**—This undoubtedly should be supervised by the pediatrist. Vomiting may persist after operation and serious diarrhea may occur. I have also seen severe convulsions in a case with continuous bilious vomiting. Ultimate recovery resulted. Postoperative vomiting may be due to the regurgitation of bile into the stomach or it may result from postoperative volvulus of the proximal portion of the small intestine used in making the anastomosis. Convulsions may likewise result from the entrance of bile into the stomach and its absorption from the gastric mucosa. Therefore gentle stomach washings with warm bicarbonate of soda solution may be instituted twelve to eighteen hours after operation, and the infant may be suspended by the shoulders in an upright position. Thus by gravity the course of the bile is assisted in taking a normal direction.

Small quantities of diluted human milk may be given either through the tube immediately following the stomach washing or by mouth, using a medicine dropper. Twenty-four hours after operation regular feedings with the medicine dropper should be instituted, and as soon as the infant is sufficiently strong it should be permitted to suck the breast. Where breast milk is unobtainable, feeding should be inaugurated with weak animal juices, to be followed by whey, pancreatized formula, or very weak whole-milk dilutions boiled or modified by Benger's Food or by flour ball and pancreatin.

Diarrhea may be controlled largely by diet and by the use of eiweissmilch or by a hypodermic injection of morphin.

To combat shock immediately after operation, hypodermoclysis of normal saline solution is valuable, or the water may be delivered to the tissues by the use of the Murphy drip, normal saline solution containing from 1 to 2 fluidrams of whisky to the pint being employed.

The utmost *finesse* of judgment is required in meeting the postoperative exigencies which arise. Great care should be exercised not to do too much, but to give nature a chance to adjust herself to the new conditions. The feeding, especially if artificial, should be supervised for some months following operation, for gastrointestinal upsets may bring serious consequences.

**Non-surgical.**—This embraces (*a*) dietetic, (*b*) mechanical, and (*c*) medicinal measures.

*Dietetic.*—In the beginning these cases should undoubtedly be kept upon the breast or returned to it if the mammary gland is still functionating sufficiently. It is my custom always to take the mother into my confidence and, after explaining to her the nature of the case, to insist that

her full co-operation is essential to a successful result. Her nervousness is in a measure overcome and a steady flow of fairly uniform milk is thus assured. If the maternal milk has been lost, recourse must be had to a wet-nurse, if this be possible. In some communities and under some conditions the services of these women cannot be obtained. In one case I received daily a small complement of milk from four different mothers, living in widely separated sections of Philadelphia. This was carried to the house, where it was mixed together, diluted with water, and fed to the infant with either a medicine dropper or through a bottle. This was continued until a satisfactory wet-nurse was secured. The beneficiary of these four, good, unselfish women is now a robust boy of over 3 years. Whatever method of feeding is adopted, it is important to insist upon strict regularity. In my experience short meals lasting two to three minutes given every hour are better tolerated than when the long-interval feeding of large meals is adopted. Vomiting is sometimes lessened by feeding the breast milk through a medicine dropper, or it may be slowly injected by means of a small syringe before removing the catheter directly following a stomach washing. Vomiting is sometimes remarkably controlled by this maneuver when it constantly follows feeding by sucking either the bottle or the breast. After feeding, the infant should lie upon its right side to favor the rapid emptying of the stomach.

Where the breast is not available we must depend upon artificial feeding. Whey may be tried for a while. If it agrees, very small amounts of whole or of skimmed milk or even cream may be added, after carefully heating the whey in order to prevent coagulation of the added milk or cream (Chapter III, page 120). I have seen some cases do

well on a highly diluted condensed milk. This contains very little protein and fat and considerable sugar, which readily furnishes the heat which these infants require so badly. If the stomach contents be sour and highly acid, any of these substances or even the milk mixtures, to which reference will be made presently, may be largely diluted with lime-water up to 50 per cent. of the entire diluent employed. It may assist in controlling vomiting. Where ordinary milk formulas are employed, large doses of sodium citrate (see later) are useful to prevent coagulation of the milk in the stomach.

I believe that simple dilutions of whole or of skimmed milk to be as useful as any of the more elaborate modifications. Especially is this true if the mixture be boiled or if Benger's Food or flour ball and pancreatin be employed to modify the curd and to assist in the digestion of the fat. High dilutions are at first employed, 1 to 2 ounces in 20 of diluent. This should either be barley-water or oatmeal-water, or plain boiled water or a mixture of equal parts of the cereal-water and boiled water. The last is usually to be preferred. Lime-water may be substituted for any of these. To the formula, modified either by Benger's Food or by flour ball, sodium citrate may in addition be added. Small doses of the formula are given often. Gradually the strength of the mixture is increased.

Additional carbohydrate is furnished by either cane-sugar or by some preparation of maltose, as Mead-Johnson's Dextri-Maltose or Loeflund's Food Maltose. In these cases I prefer the malt-sugars, on account of their rapid absorbability. They maintain body temperature and, I believe, cause a more rapid gain in weight. Some cases kept upon the breast showed improvement as far as the nutrition and

temperature were concerned by the addition to the diet of a simple 5 per cent. solution of Dextri-Maltose.

*Why it is so I cannot explain, but I have noticed the clinical fact that many cases which are doing indifferently well upon the breast alone, gaining an ounce or two a week or just holding their own, take a spurt, if given a simple formula prepared as just described.* The bottle is given at every other feeding, and then gradually the baby is transferred to artificial food entirely. Whether this be merely a coincidence, or whether it depends upon the food, thus furnishing a clue as to the ultimate cause of the spasm or hypertrophy which may be causing the obstruction, is difficult to determine, but as a practical therapeutic fact it is well worth remembering. I have only seen this occur after the use of milk treated in the following manner, viz., highly diluted, boiled, and modified either by Benger's Food or by flour ball and pancreatin.

Animal broths are at times sustaining, especially in surgical cases just preceding operation. They may be given by mouth or *per rectum*,

Enemas of peptonized milk are useful for the same purpose. Too great dependence should not be placed upon them. Their bulk should always be small, and not more than 2 should be administered during each twenty-four hours.

*Mechanical Measures.*—The one single remedy which approaches specific proportions in the management of non-surgical cases is gastric lavage. If nothing else be at hand, plain warm water will do. Normal salt solution is better, however, and better still is a solution of 1 dram of bicarbonate of soda to the pint of water. The temperature should be 100° F. The washing should be continued until

the fluid comes away clear. The daily number of washings varies with the severity of the vomiting—not less than 1 and preferably 2 or 3. If possible the washings should immediately follow a vomiting spell, and immediately after this food should be administered. (See page 363.)

In some instances the fluid enters readily enough, but the contractions of the stomach are so forceful that the contents are shot out alongside of the tube. This accomplishes as much as if the fluid were siphoned away. There is some danger, slight however, that fluid or curds may be aspirated into the larynx or bronchi and cause immediate suffocation or, later, bronchopneumonia. In order to avoid this the catheter should be immediately withdrawn during the gush of fluid and the infant inverted. As the case improves the number of washings is gradually decreased and finally omitted.

It is important to keep the rectal temperature between 99° and 100° F. With this in view the baby should be properly protected by clothing and the judicious application of *external heat.*

*Medicinal.*—Drugs are only adjuvants. I only employ them for a definite reason. Of the *bromids* I prefer the strontium or the sodium salt. The former is given in the shape of Paraf Javal's solution marketed by Chapoteaut. Each fluidram contains 7½ grains, and from 10 to 15 minims are administered in a little water before every feeding or before alternate feedings. From 1 to 2 grains of the salt dissolved in plain water may be thus employed. I have also used sodium bromid. It appears, however, to be more irritating in the stomach and more readily produces a bromid rash, which in itself may be an element of danger (Complications, page 334).

If the bromid has no effect upon the vomiting, I have made use of an occasional dose of morphin sulphate gr. $^1/_{800}$ to gr. $^1/_{800}$ by hypodermic injection. This has in some cases worked splendidly and without ill-effect. Where the appetite has failed 1 to 2 drops of the tincture of nux vomica have been of some use.

Impressed by the good effect of liquid paraffin in the treatment of constipation, I believe that this substance should be given a trial in the milder cases of incomplete obstruction. I have employed it in but 2 cases and, I believe, with some good effect in allaying pyloric spasm and in asisting the onward movement of the aliment. About ½ to 1 dram should be given three times a day. Any of the good oils, foreign or domestic, to be found on the market will answer this purpose.

Sodium citrate is a valuable agent when used in conjunction with proper feeding. Its purpose is to keep the milk liquid in the stomach, so as to assist in its easy passage through the pylorus. To infants on the breast I have given as much as 10 or 15 grains five or six times a day, before feeds. I believe however that ordinarily from 2 to 5 grains are sufficient. I find no ill-effects from its use. It should enter into the composition of every milk formula in those cases artificially fed. The dose is from 1 to 3 grains for every ounce of milk and cream in the bottle.

Codliver oil, especially in cold weather, should be used freely daily or bidaily in the form of inunctions.

## SURGICAL TREATMENT OF INFANTILE PYLORIC OBSTRUCTION.

By John B. Deaver, M.D.

When surgical treatment has been decided upon it becomes necessary to select that form of operation which will

accomplish the best result. In doing this we must be guided not only by the change in the stomach, but also the tender age of the patient.

The operations that have been done in the attempt to correct this condition are pylorodosis, pyloroplasty, gastrojejunostomy, and pylorectomy. Pylorectomy has been done but once, so far as I know, with fatal result. Gastropyloroduodenostomy has been done unsuccessfully in 1 case. Pylorodosis is an operation which may be quickly performed, requires but little exposure of the viscera, and is theoretically safe, but practically does not give the best results. In a few instances the pylorus has been split longitudinally down to but not including the mucosa (Ramstedt), instead of stretching, and death has frequently resulted from shock or from peritonitis. In my early experience with this disease I performed a number of these operations with, as a rule, unsatisfactory results; therefore I have discarded this method entirely. In 1 of my cases I had subsequently to make a posterior gastroenterostomy.

Dufour and Fredet have collected 36 operations by the Ramstedt method, with 9 deaths. One patient who recovered required gastroenterostomy later. Personally, I would strongly advise against this operation.

Posterior gastrojejunostomy is the only operation I now perform, and the results warrant, I am sure, the statement that it is the only operation to be considered. The technique of the operation is exactly the technique of posterior gastrojejunostomy in the adult, the only difference being that it is preferable to use smaller anastomosis clamps on account of the jejunum being so much smaller in the child than in the adult. The essential points to be considered in this operation in the child are, first, rapidity; second, that

the anastomosis be made as close to the duodenojejunal junction as possible, thereby preventing regurgitant vomiting; third, that 3 rows of sutures be used, the outermost of linen and the 2 innermost of chromic catgut. The linen suture should only include the serous and the muscular coats and must be introduced with great care on account of the thinness of the wall of the jejunum. Before introducing the second row of sutures divide the serous and muscular coats of the stomach and small bowel between one-fourth and one-eighth of an inch from the line of the apposed viscera. This row of sutures is then carried through the divided coats. The third row of sutures is passed after the viscera are opened, and includes all the coats.

## AFTER-TREATMENT.

The after-treatment consists in keeping the child in a sitting position in bed by a sling passed beneath the buttocks in the manner in which all cases of posterior gastroenterostomy are handled for a few days immediately after the operation. Nothing is given by mouth until after the passage of gas by bowel, which, in the majority of instances, occurs within twenty-four hours. Then, if the stomach be retentive, water, to be followed by albumin-water, broth, and similar substances are allowed. If the condition continues favorable, diluted milk formula, predigested or not, may be given. As the child continues to improve the milk formula is strengthened and a larger quantity given.

If the stomach is not retentive, or if there is vomiting irrespective of taking nourishment, the stomach is to be washed out. In fact, this is the only thing that accomplishes any good. In my experience, to give medicines, as

bismuth, cocaine, oxalate of cerium, and such other agents believed to be of some use in controlling nausea, is absolutely of no use in cases of this character.

It not infrequently happens that a few hours after operation the child will vomit some old blood which emits a disagreeable odor, and, if so, lavage should be immediately practised.

It is my practice to give these children enteroclysis for two or three days. At the end of the fourth day the bowels are opened by enema. Rarely it is necessary to give an aperient or purgative. If the condition is at all favorable for operation these cases should get well with little or no anxiety on the part of the surgeon. Procrastination, in surgical cases, in the hope that the child will be better without operation, until the condition becomes alarming, causes operation to become a matter of much moment, and the consequent responsibility of the surgeon to be correspondingly greater.

The incision is made through the middle of the right rectus muscle. In closing, the peritoneum is apposed by a continuous iodin-catgut suture. Two or more interrupted silkworm-gut sutures are passed through all tissues, down to the peritoneum. The sheath of the rectus is made to overlap and is fixed by a continuous iodin suture. The skin is closed with silkworm gut or horsehair. The interrupted stitches should not be removed for nine or ten days, the child being strapped with adhesive plaster. The plaster extends completely around the abdomen. When the stitches are removed too early, the edges of the wound may separate, causing ventral hernia. I have met this accident, but have corrected it by immediate replacing.

# CHAPTER XIII.

## SPECIAL TOPICS.

### DESCRIPTION OF APPARATUS.

SHOULD his practice bring him into frequent contact with children, the physician should have the apparatus pictured in Fig. 56 always at hand, in good condition and ready for use.

*A* consists of a *small glass funnel* (1) holding not less than 2 ounces and preferably 3. The funnel is attached to a piece of *rubber tubing* (2) about 6 to 8 inches in length. To this is connected a piece of *glass tubing* (3) 2 to 3 inches in length, and to this is finally attached a *soft, red-rubber catheter* (4), No. 22 to No. 26 French. An extra eyelet is cut into the catheter about ½ inch from the end.

*B* consists of a small, rubber, *hand-bulb syringe* (5) with a *hard-rubber tip* (6). In the figure it is connected with a *soft, red-rubber catheter,* No. 22 to No. 26 French (7).

*C* is a *glass syringe* which may be employed instead of the hard-rubber syringe, and is especially useful in nasal feeding.

*D* is a *rubber fountain syringe* holding 2 quarts (8). To the hard-rubber tip at the end is attached a No. 22 to No. 26 *soft, red-rubber catheter* (9). It may be remarked that it is not necessary for the physician to possess more than one catheter, as it can be readily removed and be attached to that apparatus being employed at the time.

*E* is a *sharp-pointed, hollow, steel needle* (10) connected to a *piece of rubber tubing* (11). If the catheter (4) be removed in *A* and this rubber tubing with the needle be connected to the glass tubing (3), a convenient apparatus for hypodermoclysis or for intravenous injection (by gravity) is secured.

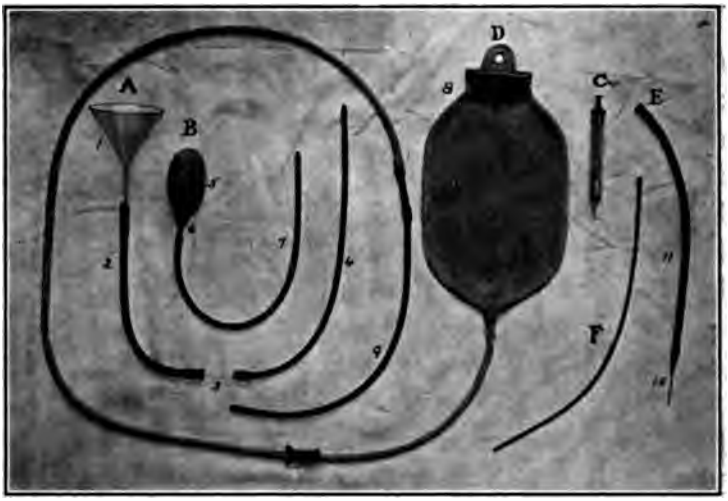



Fig. 56.—*A*, glass funnel (1), rubber tubing (2), glass connecting tubing (3), catheter No. 22 to No. 26 French (4). *B*, small, rubber, hand-bulb syringe (5), small, hard-rubber connecting tip (6), catheter No. 22 to No. 26 French (7). *C*, glass syringe. *D*, fountain syringe (8), catheter No. 22 to No. 26 French (9). *E*, hollow needle (10), rubber tubing (11). *F*, smallest caliber catheter.

*F* is the *very smallest red-rubber catheter obtainable*, employed in nasal feeding.

It will thus be seen that with this apparatus the physician is equipped to perform such useful maneuvers as stomach washing; feeding by stomach-tube; nasal feeding; the administration of medicine via the tube, if the patient cannot swallow; bowel irrigation; the giving of a nutrient

or medicinal enema (high or low), and to administer saline or other medicinal solutions by hypodermoclysis or intravenously.

## STOMACH WASHING (LAVAGE).

**Solutions Employed.**—Plain faucet-water will do. Sterile water is better. Normal saline soluton is still better. A solution containing 1 dram of sodium chlorid and 1 dram of bicarbonate of soda to the pint is best for routine purposes. For special occasions tannic acid (1 per cent. to 2 per cent.), potassium permanganate 1 : 8000, silver nitrate 1 : 10,000, may be of service in the presence of bleeding, morphin or other alkaloidal poisoning, or gastric ulceration or catarrh. For the control of the bleeding in gastric ulcer of adults Rodman recommends filling the stomach with hot water, the temperature being as high as is endurable by the patient. For ordinary purposes the *temperature* of the solution should be that of the body—98° to 100° F. The *quantity employed* depends upon the indication for which the washing is done. The washing is continued until the indication is overcome or mitigated. Ordinarily from 1 to 2 quarts are employed. As a rule, but 1 washing a day is allowed, although if much benefit follow, as in some cases of pyloric obstruction, it may be repeated two, three, and even four times within twenty-four hours.

**Technique.**—Apparatus *A* is employed. The patient is placed flat upon the back and wrapped in a small sheet or blanket in order to secure the arms. The head is steadied in the median line by an assistant. The catheter is made moist with the solution to be used. The tip of the catheter is passed along the dorsum of the tongue until it touches

the postpharyngeal wall. Pressure is continued and the catheter will glide directly into the esophagus, through which it enters the stomach. The funnel is then held in a vertical position to allow gas to be expelled. This does not always occur, but some of the gastric contents commonly appear at the glass connecting-tubing or shoot into and sometimes out of the funnel. The fluid is now poured into the funnel and, unless the infant struggles, it will gradually enter the stomach. As it disappears from the funnel the latter is again filled. Just as the fluid is about to disappear for the second or the third time, depending upon the age of the baby, the funnel is depressed below the level of the patient and the gastric contents are siphoned into a receptacle. This maneuver is again repeated. This refilling and siphoning are continued until the fluid returns clear (Figs. 57 and 58).

If the patient struggles, and in older children, the task becomes less easy. The patient cries and compresses its abdominal muscles, and the fluid will not enter the stomach, but moves up and down in the apparatus. If the indication for the washing is urgent, the funnel must be patiently held in the vertical position until the infant relaxes or in some cases the operation must be abandoned. The straining may be so great as to cause the tube to be forcibly expelled through the mouth. Under these circumstances the tube is to be replaced two or three times before the attempt is abandoned. Straining may cause the fluid to gush out of the infant's mouth. This does not interfere with the accomplishment of a successful result. The stomach is cleansed whether the fluid is returned through the apparatus or via the infant's mouth. In yet other instances the catheter may become blocked by tough mucus or curds, or both.

Under these circumstances the tube may be withdrawn and an extra eyelet may be cut into its side, or the apparatus may be filled with the solution to be employed before pass-

Fig. 57.—Stomach washing. The funnel is held erect to allow the fluid to enter the stomach.

ing the catheter. The tubing is pinched until the catheter enters the stomach. When release of pressure is made the fluid will flow because, the apparatus being filled, in view of

the law of the impenetrability of matter (two things cannot occupy the same place at the same time), no curd nor mucus can enter the catheter. The entrance of the fluid

Fig. 58.—Stomach washing. The funnel is depressed to filter away the stomach contents, which flow into the bowl.

itself into the stomach will cause the curd or mucus to be broken up, and thus also the probability of the one or the other blocking the apparatus is materially lessened.

**Enemata.**—Apparatus *B* is employed. An enema may be either *high* or *low.* A low enema is given below the internal sphincter, its purpose being to empty the rectum. A high enema is given above the internal sphincter. In giving the low enema the small, rubber, hand-bulb syringe is employed. In giving the high enema this apparatus with the catheter attached is used. The purpose of the high enema may be to cleanse the rectum and sigmoid or to place medicine or nutriment into the lower bowel. For cleansing purposes plain simple water or saline solution, or a mixture of soap and water with the addition of a small amount of turpentine and glycerin, may be employed. A high enema should always be preceded by a low enema, thus avoiding blocking of the catheter by feces. The catheter is anointed and passed within the bowel for a distance of from 4 to 6 or 8 inches, care being taken that the catheter does not curl upon itself. After being properly placed the solution to be employed is injected into the bowel through the catheter by means of the small, rubber, rectal syringe, or by means of gravity, use being made of a funnel or a fountain syringe.

A high enema may also be introduced purely by gravity without the use of the catheter. The patient is simply placed in the knee-chest position and the tip of the fountain syringe in apparatus *D* is anointed and gently inserted into the rectum. The bag containing the fluid is held or hung about 2 or 3 feet above the patient, and the fluid is allowed to gently enter the intestinal canal by the practice of intermittent compression upon the rubber tube. Not more than 5 or 6 ounces of fluid should be permitted to enter the bowel (Fig. 61). Within a few minutes the patient will expel the enema and a large amount of feces.

## COLONIC IRRIGATION.

**Indications.**—When properly employed, colonic washing constitutes a useful therapeutic asset. It is, however, not

Fig. 59.—Colonic irrigation with the catheter. The tip is introduced and the buttocks are seen to be pressed together (so that no water can escape) in order to balloon the rectum.

without danger, especially when continued without reason over a long period of time. A distinct indication must exist

and the washings must cease as soon as this is overcome, or it appears clear that they will accomplish no good. In

Fig. 60—Colonic irrigation with catheter. The catheter has been pushed in for its entire length and the water is seen escaping alongside of it and over the buttocks.

chronic constipation a single irrigation is useful to unload a crowded bowel. In this condition it should not be employed more than once within a fortnight. It is also indi-

cated in eclampsia, summer complaint (intoxication), intestinal parasites, intestinal putrefaction, dyspeptic diarrhea,

Fig. 61.—Giving a colonic irrigation or a high enema without inserting the catheter. The infant is placed in the knee-chest posture and the hard-rubber tip of the syringe is simply placed within the anus and the water flows by gravity.

and in dysentery. It is one of the most powerful means of reducing high temperature.

**Technique.**—Plain sterile water, normal salt solution, or medicated fluids may be employed. In intestinal ulceration a weak solution of silver nitrate 1 : 10,000 or a 1 or a 2 per cent. solution of tannic acid may prove beneficial. The temperature of the fluid varies as to the indications to be met. In all instances, except in fever, it should be between 98° and 100° F. If the patient has fever, cold water or, better, gradually cooled water, or even ice-water, is valuable.

Apparatus *D* is employed. The irrigation is preceded by a low enema. The child is placed on its left side and under its buttocks is arranged a suitable piece of rubber or a small Kelly pad, which drains the fluid into a bucket. The catheter is oiled. The stop-cock is released and the flow of fluid expels all air from the catheter. The flow is now shut off and the tip of the catheter inserted just beyond the internal sphincter. The fluid is again allowed to flow and the buttocks closely pressed together without compressing the catheter (Fig. 59). No fluid can escape and the lower bowel is ballooned. After a minute or two the catheter is gently pushed in for its entire length. As the colon fills, the belly is gently massaged. The fluid escapes in spurts from the anus along the sides of the catheter (Fig. 60). The irrigation is continued until the fluid returns clear.

The irrigation may be accomplished without the use of the catheter, as in giving a high enema, the child being placed in the knee-chest posture (Fig. 61) and the refilling and the emptying of the bowel being continued until it is cleansed. At intervals the child may be placed upon its back with its buttocks elevated while the abdomen is massaged upward along the left side across and down the right. This insures the fluid reaching the ascending colon.

**Accidents.**—In experienced hands nothing more than an interference with the easy flow of the fluid due to the bending of the catheter upon itself occurs. As the physician pushes the instrument into the bowel the tip of the catheter reappears again at the anus. This may best be avoided by thoroughly ballooning the lower gut, or by passing the index-finger into the rectum and thus guiding the tip of the catheter past any obstruction. If the catheter becomes obstructed from any cause, this fact may be determined by disconnecting it from the apparatus temporarily, when no fluid will flow through it from the bowel. There is some slight danger of rupturing an ulcerated bowel if the rubber bag be elevated too high above the child.

## NASAL FEEDING.

**Indications.**—Unconsciousness. If the child for any other reason cannot swallow, as in inflammatory and infectious conditions of the mouth and throat and after certain operative measures upon these parts, and in cases of tetanus.

**Technique.**—The infant's hands and arms are secured by a towel wrapped around its body. The head is steadied in the median line. Apparati *F* and *C* are employed. The calibre of the catheter must be the smallest obtainable. The catheter is anointed with oil. It is passed toward the posterior nares, along the floor of the nose. The index-finger of the free hand is passed into the fauces to guide the tip into the esophagus, otherwise, striking the prominence of a cervical vertebra, it may become impinged here and the bulk of the tube accumulate in the throat, or the tip may come out of the mouth. After the tip has entered the stomach, as is evidenced by the appearance of gastric contents at the outlet of the tube projecting from the nose, the food,

previously warmed, may be slowly injected by means of the glass syringe (*C*). Instead of using the syringe the food

Fig. 62.—Nasal feeding.

may be permitted to slowly gravitate by connecting a small glass funnel (*A*, 1) with the projecting end of the catheter and into this the food is emptied.

Where necessary the stomach may be washed out through the nose before the food is allowed to enter, and medicine may also be administered in this fashion. The maneuver of nasal feeding is usually easily accomplished, and without inconvenience to the infant.

## FEEDING BY STOMACH-TUBE (GAVAGE).

**Indications.**—When the patient will not or can not swallow. This may be due to inflammatory conditions of the throat or mouth, to paralytic phenomena, as after diphtheria or in cases of ascending paralysis, or in tetanus. Inability to swallow is a part of the clinical picture of coma, as seen in convulsions, meningitis, infantile paralysis, after head trauma, and during nephritis. Gavage is a valuable adjunct in some cases of forced feeding or in anorexia, or in cases of persistent vomiting associated with acute intestinal intoxication. Food given in this manner is often retained when it would be vomited if taken in the ordinary way. To the careful clinical observer gavage will suggest itself in many other conditions, not necessary to be enumerated. It should be discontinued the moment the necessity for it ceases to exist.

**Technique.**—The same apparatus (*A*) is employed as in stomach washing, and the same method of introducing the tube is followed. The food, adapted to the needs of the individual case, but always liquid and previously warmed, is allowed to slowly enter the stomach by the attendant making regular but intermittent compression upon the tube. On the other hand, one may dispense with the funnel and the aliment may be slowly injected through the catheter by means of a glass or other syringe, as in nasal feeding. During withdrawal the tube must be compressed and re-

moved with one swift stroke, between gags. Otherwise the gastric contents may be shot out around, with and after the tube.

### FEEDING BY BOWEL.

**Nutrient Enemata.**—The purpose of this method of feeding is to sustain life over critical periods of acute food intolerance or anorexia, and to reinforce mouth feeding when the stomach is non-retentive. It may also be employed during coma from any cause. While it should be tried as a *dernier ressort,* in my opinion it rarely renders signal service in saving life. It may also be employed after operations upon the stomach or upon the other organs of the upper abdomen. It cannot be depended upon as the sole source of introducing nourishment for any great period of time.

**Technique.**—The lower bowel should previously be emptied by a suppository or preferably by a cleansing high enema of simple saline solution. After this the patient should rest at least one-half hour in order to permit any rectal irritation to pass away. Apparatus *B* is employed. The rubber catheter is well anointed with oil and introduced into the bowel, for a distance of from 4 or 5 inches. This is accomplished with a variable degree of ease in different individuals. The infant is placed on its left side and the buttocks are slightly elevated. The enema heated to 100° F. is slowly injected by means of the soft-rubber, hand-bulb syringe or by means of a glass syringe, or it is allowed to flow in by gravity, by connecting apparatus *A* at the glass tubing (3) to the free end of the catheter. From ten to fifteen minutes should be consumed in getting the fluid into the bowel, whatever method be employed. When all has

entered, the catheter is pinched and swiftly withdrawn. The infant is permitted to lie on its left side with its buttocks elevated, or it is placed for a few moments in the knee-chest posture while the colon is massaged upward on the left side, across, and down the right. The bulk of the enema should never exceed 4 to 5 ounces in a child and in an infant never more than 1 to 2 ounces. Not more than 2 nutrient enemata should be given within twenty-four hours, and they should be at least twelve hours apart. Any attempt to increase the bulk or the frequency of administration will defeat the purpose for which they are given, for the rectum speedily becomes irritable and expulsion occurs.

**Composition.**— Various formulæ have been given. All are perhaps good. None appear to me to possess any special advantage. The following is offered as being suitable in most instances:—

One egg
4 oz. of completely pancreatized milk (at least 30 minutes).
1 oz. of water.
Deodorized tincture of opium, 1 to 5 drops.
Ex. of pancreatin, 10 grains.
Sodium bicarbonate, 10 grains.

This may be given in whole or in part. If desired, from 10 to 60 minims of whisky may be added.

## FEEDING DURING THE ACUTE INFECTIOUS DISEASES.

The burden of an infectious process is shared by all the vital organs. From this depression of function the alimentary canal does not escape. Hence the tolerance for food, *i.e.*, the power for digestion and for assimilation, is variously diminished, depending upon the resistance of the individual and upon the severity, character, and duration

of the infectious disease. This diminished digestive power is commonly seen when, during the course of an acute infection, the bowel movements, which previously were normal, now show the evidences of dyspepsia, curds, mucus, greenish discoloration. So much so is this the case that not infrequently the mistake is made of overlooking the infection, which may be more or less obscure, and of regarding the case as purely one of food intolerance or of alimentary disturbance. I have seen this error made repeatedly, for instance, with reference to acute otitis media. An infant falls ill with fever and the bowels become disturbed. The patient is treated with reference to these until a discharge appears at the ear, or a specialist having been called, or the doctor himself becoming suspicious from, for instance, the high leucocyte count, or from a general knowledge that inflamed ears often occur in infants without pain and with fever as their sole symptom, the error is discovered before rupture occurs as the result of a careful ear examination. In one instance this error almost led to a fatal issue, as an intense mastoid infection, requiring operation, occurred. The child had been ill a week before the ear infection was detected.

The character of the infection, *i.e.*, the nature of the toxin, has a very important determinating influence upon the degree of severity of the food intolerance. Thus the toxin of pneumonia seems very potent in this respect, while, on the other hand, those of the acute exanthemata, scarlet fever, measles and varicella, and of diphtheria seem to exert scarcely any serious effect upon the digestion. Influenza, on the other hand, is very depressing. With the exception perhaps of scarlet fever, a speedy return may be made to the normal amounts of the food to which the in-

dividual has been accustomed during health. Even in this exception we must be cautious, not because of the reduction in food tolerance *per se*, but because the scarlatinal toxin is especially irritating to the renal tissue. Nephritis commonly results, and it is with a view of preventing this complication that special measures must be pursued.

The damaging effects of the pneumotoxin upon food tolerance and the best means of overcoming it are of sufficient importance to require detailed comment. The pneumotoxin probably acts in two ways. First, simply as most toxins act—by diminishing the functional activity of the glands of digestion and the assimilative apparatus, and, second, by directly paralyzing, in susceptible individuals, the unstriped muscle-fibre of the intestines, because tympanites is a common complication of this disease. It should also be emphasized that it is a highly dangerous one, and one of the most fatal. From the outset, therefore, it must be borne in mind, and every means should be employed to prevent its incidence or to mitigate its severity, or to remove it entirely. The last ofttimes is a baffling and impossible task.

The author recommends that in nurslings mother's milk should if possible be the sole source of nutriment. If the infant be bottle-fed, milk in all forms should be excluded, if possible, as well as sugars and starches. If it be impossible to omit milk entirely, it should be given skimmed and highly diluted and pancreatized, or modified by the addition of flour ball and pancreatin, or of Benger's Food. Reliance should be placed mainly upon animal juices and broths and upon protein foods. The last, in sucklings, should consist of egg-albumin water, in addition to the animal juices. In older children skinned mashed peas and

Lima beans and eggs boiled or coddled two minutes should be employed. Breadcrumbs made of dry stale bread may be rubbed up with the egg. In addition to the milk preparations above indicated, Finkelstein's eiweissmilch or plain buttermilk, or one-third milk and two-thirds water, boiled with Larosan, may be employed. Should constipation occur as the result of this feeding, rectal enemata, suppositories, or tonic laxatives, as the aromatic fluidextract of cascara sagrada in ½-dram doses, should be used. Drastic purgatives, as calomel and castor oil, often cause the tympanites to become worse by further relaxing the intestinal muscularis. The lack of sugar may be met by the use of saccharin. Water in abundance should be given to attenuate the pneumotoxin.

Aside from the dietary measures advocated, the good effect of the milk of asafetida in a dose of ½ or 1 dram by mouth, or of 2 ounces by enema alone, or combined with 10 grains of charcoal, should not be forgotten. While serving as interne on my service at the Mt. Sinai Hospital, Dr. M. I. Moss devised the following medicinal enema, which was frequently employed with excellent effect:—

One-half ounce of an emulsion made with acacia contains 5 minims of the spirits of turpentine, 2 fluidrams of the emulsion of asafetida, and 1 dram each of powdered charcoal and bismuth subcarbonate.

The application of cold compresses, of hot turpentine stupes, or of the warmed spice poultice (a small oblong bag is made of muslin and partly filled with allspice and securely sewed on all four sides) to the abdomen, may often assist in reducing the tympanites. I have seen very little effect from the hypodermic injection of eserin salicylate or of atropin sulphate. Digestants, as the extract of pan-

creatin and of taka-diastase, 2 gr. each, administered four times daily, may be of some assistance. The permanent insertion of a No. 22 to No. 26 French soft-rubber catheter high into the bowel may facilitate the passage of the gas.

### FEEDING IN NEPHRITIS.

After following many cases of acute and subacute nephritis to recovery I am convinced that the investigations of Martin H. Fischer with reference to sodium chlorid are not only correct, but that they provide invaluable data in the treatment of this disease. I therefore advocate the addition of salt to the diet of all nephritics in plentiful quantities, and administer it as well *per rectum, hypodermically* and *intravenously*. Aside from this there is no need for further comment except to advise the administration of wholesome, well-cooked, and easily digested foods in small quantities.

### FEEDING DURING INTUBATION.

The blandest of food should be given in order not to induce coughing, as this may cause the tube to be expelled. Milk and milk foods are best. Infants at the breast very often can continue this method of feeding, provided the milk be pumped and fed with a spoon or dropper. If swallowing cannot be accomplished the food may be given through a stomach-tube or, better yet, by nasal feeding. The question of feeding during intubation is largely a problem of position. Some patients have trouble when attempting to swallow liquids. This may be overcome by holding the baby so that its head is lower than its trunk. This is known as the Casselberry position.

## HYPODERMOCLYSIS.

This means the injection of fluids, usually normal saline solution, under the skin for the purpose of absorption.

**Indications.**—It is useful in all conditions associated with a great loss of the body fluid and in acute or chronic toxic states. Thus it finds its chief indication in cholera infantum (intoxication), hemorrhage, certain types of infantile atrophy, chronic diarrhea, acute infectious diseases associated with suppression of the urine, asphyxia, acute and chronic nephritis, uremia, certain anemias, and sometimes after operation.

**Physiologic Action.**—The effect produced depends largely upon the extra amount of water which enters the system and, according to the researches of Martin H. Fischer, the sodium chlorid has a direct specific action in controlling the solution of the colloidal substances of which the kidney is composed. This is a direct contradiction to the commonly accepted opinion that common salt is largely contraindicated in the nephritides. The imbibed water increases the normal fluids of the body and bathes the dried and parched tissues. The volume of the blood is increased and the arterial pressure augmented. The force and the volume of the cardiac beat is strengthened. The water dilutes the toxins and minimizes their deleterious action upon the internal viscera. The chlorid of sodium inhibits the action of acids in causing the solution of the normal tissue colloids. The increased diuresis causes the more rapid elimination of these toxins.

**Technique.**—Apparatus *A* is employed except that the catheter (4) is replaced by connecting apparatus *E* to the glass tubing (3) of *A*. The skin of the abdomen is

the preferable site for injection. A point is sterilized by the application of a little tincture of iodine. The apparatus is filled with the saline solution and all air-bubbles are

Fig. 63.—Hypodermoclysis.

eliminated. The needle is introduced well under the skin into the subcutaneous cellular tissue. The compression upon the rubber tubing is released. The funnel is elevated and

the fluid is permitted to flow gently by gravity. A tumor immediately appears and increases in size according to the amount of fluid injected (Fig. 63). The tumor is gently massaged in order to facilitate the distribution of the solution under the skin. Should the flow appear to be inhibited the needle may be pushed in to its full length and pointed in different directions from time to time. When sufficient fluid has entered (from 2 to 6 ounces) the needle is withdrawn and the puncture sealed with collodion and

Fig. 64.—Necrosis and ulceration from the subcutaneous injection of carbonate of soda and sodium chlorid solution. Slough due to the alkali.

a bandage applied. Within a brief space of time, from one-half to one hour, the fluid will have been absorbed and the swelling will have disappeared. The injection of the fluid is accompanied by very little pain. The temperature of the solution in the funnel should be maintained at about 120° F. As the fluid leaves the needle-point the temperature will be about normal. Too large a quantity of fluid is not to be injected at one site, nor should the same site be selected too often. Only in this way may gangrene of the skin and ulceration be prevented, especially in delicate infants. Should a white area appear upon the swelling the injection

should immediately cease, as this means that the circulation of that particular spot has been cut off and gangrene of the skin may result. This phenomenon occurs not infrequently as the result of placing the needle *between* the layers of the skin instead of *under* the skin, or, as above indicated, from permitting too much fluid to enter. *Alkalies,* such as the bicarbonate of soda or the carbonate of soda, should never be employed in the solution, as they invariably produce gangrene and ulceration (Fig. 64). Abscesses are a rare occurrence.

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